


Atomic Structure

- ___ 1. What is the total number of electrons in the 2p sublevel of a chlorine atom in the ground state? (1) 6; (2) 2; (3) 3; (4) 5.
- ___ 2. Which is the electron configuration of an atom in the excited state? (1) $1s^2, 2s^1$; (2) $1s^2, 2s^2, 2p^1$; (3) $1s^2, 2s^2, 2p^5$; (4) $1s^2, 2s^2, 2p^2, 3s^1$.
-  3. A Ca (+2) ion differs from a Ca atom in that the Ca (2+) ion has (1) more protons; (2) fewer protons; (3) more electrons; (4) fewer electrons.
- ___ 4. At the end of 12 days, 1/4 of an original sample of a radioactive element remains. What is the half-life of the element? (1) 24 days; (2) 48 days; (3) 3 days; (4) 6 days.
- ___ 5. The total number of orbitals in the 4f sublevel is (1) 1; (2) 5; (3) 3; (4) 7.
- ___ 6. Which electron transition is accompanied by the emission of energy? (1) 1s to 2s; (2) 2s to 2p; (3) 3p to 3s; (4) 3p to 4p.
- ___ 7. What is the total number of nucleons (protons and neutrons) in an atom of selenium (atomic no.=34, atomic mass= 79)? (1) 34; (2) 45; (3) 79; (4) 113.
- ___ 8. What is the total number of principal energy levels that are completely filled in an atom of magnesium in the ground state? (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 9. What is the maximum number of electrons that can occupy the 4d sublevel? (1) 6; (2) 2; (3) 10; (4) 14.
- ___ 10. Which sublevels are occupied in the outermost principal energy level of an argon atom in the ground state? (1) 3s and 3d; (2) 3s and 3p; (3) 2s and 3p; (4) 2p and 3d.
- ___ 11. Which electron configuration represents an atom in the excited state? (1) $1s^2, 2s^2$; (2) $1s^2, 3p^1$; (3) $1s^2, 2s^2, 2p^5$; (4) $1s^2, 2s^2, 2p^6$.
- ___ 12. Which element has an atom in the ground state with the most loosely bound electron? (1) He; (2) As; (3) Xe; (4) Cs.
- ___ 13. The half-life of C-14 is 5730 years. What fraction of a 1 gram sample of C-14 would remain after 17,190 years? (1) 1/2; (2) 1/4; (3) 1/8; (4) 1/16.
- ___ 14. Isotopes of an element have a different (1) number of electrons; (2) number of protons; (3) atomic number; (4) mass number.
- ___ 15. A neutral atom of an element has an electron configuration of 2-8-2. What is the total number of p electrons in this atom? (1) 6; (2) 2; (3) 10; (4) 12.
- ___ 16. A neutral oxygen atom (O) differs from an oxide ion in that the atom has (1) more electrons; (2) fewer electrons; (3) more protons; (4) fewer protons.
- ___ 17. Which is the electron configuration of a hydrogen atom with an atomic mass of 3 in the ground state? (1) $1s^1$; (2) $1s^2$; (3) $1s^2, 2s^1$; (4) $1s^2, 2s^2$.

- ___ 18. When an electron in an atom of hydrogen moves from the second to the first principal energy level then the result is the emission of (1) a beta particle; (2) an alpha particle; (3) quantized energy; (4) gamma rays.
- ___ 19. How many occupied sublevels are in an atom of carbon in the ground state? (1) 5; (2) 6; (3) 3; (4) 4.
- ___ 20. What is the total number of electrons in the 2nd principal energy level of a chlorine atom in the ground state? (1) 5; (2) 7; (3) 8; (4) 17.
- ___ 21. What is the total number of neutrons in an atom of K, whose mass is 39 and atomic number is 19? (1) 19; (2) 20; (3) 39; (4) 58.
- ___ 22. What total mass of a 16 gram sample of Co^{60} will remain unchanged after 15.9 years? (Half life = 5.3 years) (1) 1.0 G; (2) 2.0 G; (3) 8.0 G; (4) 4.0 G.
- ___ 23. The amount of hydrogen chloride that the formula HCl represents is one (1) atom; (2) gram; (3) liter; (4) molecule.
- ___ 24. The mass number of an atom is equal to the total number of its (1) electrons only; (2) protons only; (3) electrons and protons; (4) protons and neutrons.
- ___ 25. Which electron configuration represents a neutral atom of nitrogen in an excited state? (1) $1s^2, 2s^2, 2p^3$; (2) $1s^2, 2s^2, 2p^4$; (3) $1s^2, 2s^1, 2p^4$; (4) $1s^2, 2s^1, 2p^5$.
- ___ 26. How many orbitals in a sulfur atom in the ground state contain only one electron? (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 27. How many orbitals are completely filled in an atom of nitrogen in the ground state? (1) 5; (2) 2; (3) 3; (4) 4.
- ___ 28. Which atom in the ground state has only one unpaired electron in its valence shell? (1) boron; (2) carbon; (3) nitrogen; (4) oxygen.
- ___ 29. What is the total number of electrons in the 2nd principal energy level of a calcium atom in the ground state? (1) 6; (2) 2; (3) 8; (4) 18.
- ___ 30. The number of protons in an atom of Cl^{36} is (1) 17; (2) 18; (3) 35; (4) 36.
- ___ 31. Which is the electron configuration of a noble gas atom in the excited state? (1) $1s^1$; (2) $1s^1, 2s^1$; (3) $1s^2, 2s^2$; (4) $1s^2, 2s^2, 2p^2$.
- ___ 32. When a chlorine atom reacts with a sodium atom to form an ion then the chlorine atom will (1) lose one electron; (2) lose two electrons; (3) gain one electron; (4) gain two electrons.
- ___ 33. As a substance changes from a liquid to a gas the average distance between molecules (1) decreases; (2) increases; (3) remains the same.
- ___ 34. An O^{2-} ion has the same electron configuration as (1) S^{2-} ; (2) Ca^{2+} ; (3) F^{1-} ; (4) K.
- ___ 35. What is the maximum number of electrons that can occupy the third principal energy level? (1) 8; (2) 10; (3) 18; (4) 32.

- ___ 36. Element X exists in three isotopic forms. The isotopic mixture consists of 10.0% X^{10} , 20.0% X^{11} and 70.0% X^{12} . What is the average atomic mass of this element? (1) 11.0; (2) 11.6; (3) 12.0; (4) 12.4.
- ___ 37. Which electron configuration represents an element having the highest first ionization energy? (1) $1s^1$; (2) $1s^2$; (3) $1s^2, 2s^1$; (4) $1s^2, 2s^2$.
- ___ 38. Which represents the correct electron distribution of a transition element in the ground state for the Bohr orbits K-L-M-N? (1) 2-8-8-1; (2) 2-8-8-2; (3) 2-8-18-2; (4) 2-8-18-3.
- ___ 39. The nucleus of a fluorine atom has a charge of (1) +1; (2) +9; (3) +19; (4) 0.
- ___ 40. How many sublevels are completely occupied in the second principal energy level of a sodium atom in the ground state? (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 41. The correct formula for aluminum sulfate is (1) Al_2S_3 ; (2) Al_3S_2 ; (3) $Al_2(SO_4)_3$; (4) $Al_3(SO_4)_2$.
- ___ 42. An atom of which element in the ground state contains electrons with a principal quantum number (n) of 4? (1) Kr; (2) Ar; (3) Ne; (4) He.
- ___ 43. What is the total number of neutrons in an atom of Fluorine. Fluorine has an atomic number of 9 and a mass of 19. (1) 9; (2) 10; (3) 19; (4) 28.
- ___ 44. A Mg^{2+} ion has the same electron configuration as (1) Na; (2) Ar; (3) F^1 ; (4) Ca^{2+} .
- ___ 45. A sample of iodine-131 contains 10 grams. Approximately how much iodine-131 will remain after 24 days? (Half life = 8 days) (1) 1.3 G; (2) 2.5 G; (3) 5.0 G; (4) 10 G.
- ___ 46. The characteristic spectrum of an element is produced when (1) the energy level of the nucleus is increased; (2) electrons drop back to lower energy levels; (3) electrons are raised to higher energy levels; (4) electrons are emitted by an atom.
- ___ 47. Which of the following sublevels represents the lowest energy level? (1) 4s; (2) 4p; (3) 4d; (4) 4f.
- ___ 48. What is the maximum number of electrons that can occupy the p sublevel of an atom? (1) 6; (2) 2; (3) 8; (4) 10.
- ___ 49. Which orbital may contain the valence electrons of a calcium atom? (1) 1s; (2) 2s; (3) 3s; (4) 4s.
- ___ 50. Which energy level transition represents the greatest absorption of energy? (1) 1s to 3p; (2) 2p to 3s; (3) 3s to 3p; (4) 3s to 4s.
- ___ 51. As a sulfur atom becomes a sulfide ion the radius (1) decreases; (2) increases; (3) remains the same.
- ___ 52. What is the number of orbitals that make up any p sublevel? (1) 1; (2) 2; (3) 3; (4) 5.

- ___ 53. Which particle has a mass of approximately 1 mass unit and a unit positive charge? (1) neutron; (2) proton; (3) electron; (4) alpha particle.
- ___ 54. When a radioactive nucleus emits a beta particle then the atom's (1) mass number is increased by 1; (2) mass number is decreased by 1; (3) atomic number is increased by 1; (4) atomic number is decreased by 1.
- ___ 55. The maximum number of electrons in the 3d sublevel is (1) 6; (2) 2; (3) 8; (4) 10.
- ___ 56. Which two particles have the same electronic configuration? (1) Cl^{1+} and F^{1-} ; (2) Cl^{1-} and S^{2-} ; (3) Cl^{1-} and Ne; (4) Cl^{1-} and K.
- ___ 57. Which furnishes evidence that electrons in atoms are in definite energy levels? (1) electronegativities; (2) atomic radii; (3) mass defects; (4) spectral lines.
- ___ 58. When an atom of chlorine becomes a chloride ion then its size (1) decreases; (2) increases; (3) remains the same.
- ___ 59. What is the maximum number of electrons that can occupy the second principal energy level? (1) 6; (2) 8; (3) 18; (4) 32.
- ___ 60. The structure of an alpha particle is the same as a (1) lithium atom; (2) neon atom; (3) hydrogen nucleus; (4) helium nucleus.
- ___ 61. What is the total number of electrons in a Mg^{2+} ion? (1) 10; (2) 2; (3) 12; (4) 24.
- ___ 62. Which atom has the strongest attraction for electrons? (1) Cl; (2) F; (3) Br; (4) I.
- ___ 63. Which species has a negative charge? (1) a lithium ion; (2) an alpha particle; (3) an aluminum ion; (4) a beta particle.
- ___ 64. Which atom in the ground state has three unpaired electrons in its outermost principal energy level? (1) Li; (2) B; (3) N; (4) Ne.
- ___ 65. What is the total number of valence electrons in an atom of phosphorus in the ground state? (1) 5; (2) 2; (3) 3; (4) 7.
- ___ 66. Which particle is electrically neutral? (1) proton; (2) positron; (3) neutron; (4) electron.
- ___ 67. An atom that contains 35 protons, 45 neutrons, and 35 electrons has an atomic number of (1) 35; (2) 45; (3) 80; (4) 115.
- ___ 68. An electron has a charge identical to that of (1) a neutron; (2) a proton; (3) an alpha particle; (4) a beta particle.
- ___ 69. Two isotopes of the same element will have the same number of (1) neutrons and electrons; (2) neutrons and nucleons; (3) protons and nucleons; (4) protons and electrons.
- ___ 70. What is the number of orbitals in the first principal energy level? (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 71. The maximum number of sublevels in the second principal energy level is (1) 1;

(2) 2; (3) 3; (4) 4.

- ___ 72. Which represents the electron configuration of an isotope of oxygen in the ground state? (1) $1s^2, 2s^2, 2p^1$; (2) $1s^2, 2s^2, 2p^2$; (3) $1s^2, 2s^2, 2p^3$; (4) $1s^2, 2s^2, 2p^4$.
- ___ 73. Which sample contains the same number of atoms as 24 grams of carbon? (1) 80. G. Ar; (2) 24 G. Mg; (3) 10. G. Ne; (4) 4.0 G. He.
- ___ 74. Which element requires the least amount of energy to remove its most loosely bound electron? (1) Li; (2) Mg; (3) Ba; (4) Ca.
- ___ 75. The maximum number of electrons possible in any principal energy level (principal quantum number = n) is equal to (1) n ; (2) $2n$; (3) n^2 ; (4) $2n^2$.
- ___ 76. What is the number of sublevels in the fourth principal energy level? (1) 1; (2) 2; (3) 3; (4) 4.
- ___ 77. How many neutrons are in the nucleus of an atom that has an atomic number of 17 and a mass number of 35? (1) 17; (2) 18; (3) 35; (4) 52.
- ___ 78. Which atom has the largest radius? (1) Li; (2) Be; (3) C; (4) F.
- ___ 79. Isotopes are atoms which have different (1) atomic masses; (2) atomic numbers; (3) atomic radii; (4) electron configurations.
- ___ 80. When the aluminum atom is in the ground state then how many orbitals contain only one electron? (1) 1; (2) 2; (3) 3; (4) 13.
- ___ 81. Van der Waals forces will increase when there is a decrease in the (1) number of molecules; (2) size of molecules; (3) distance between molecules; (4) mass of molecules.
- ___ 82. What is the total charge on an ion that contains 10 electrons, 13 protons, and 15 neutrons? (1) -1; (2) +1; (3) -3; (4) +3.
- ___ 83. The element whose properties are most similar to those of tellurium is (1) Be; (2) S; (3) O; (4) Po.
- ___ 84. Which atom has the greatest affinity for an electron? (1) Li; (2) Br; (3) Na; (4) Cl.
- ___ 85. Which energy level fills after the 4s energy level is filled? (1) 4p; (2) 4d; (3) 3d; (4) 5s.
- ___ 86. The total number of completely filled orbitals in an atom of nitrogen in the ground state is (1) 1; (2) 2; (3) 3; (4) 5.
- ___ 87. The nucleus of an atom consists of 8 protons and 6 neutrons. The total number of electrons present in a neutral atom of this element is (1) 6; (2) 2; (3) 8; (4) 14.
- ___ 88. If the electronegativity difference between the elements in compound NaX is 3.1 then the atom represented by X is (1) F; (2) Cl; (3) Br; (4) I.
- ___ 89. Potassium forms an ion with a charge of (1) +1 by losing one electron; (2) -1 by

losing one electron; (3) +1 by gaining one electron; (4) -1 by gaining one electron.

- ___ 90. Which element will form an ion whose ionic radius is larger than its atomic radius? (1) K; (2) F; (3) Li; (4) Mg.
- ___ 91. The atom of which of the following elements requires the least amount of energy to remove the most loosely bound electrons? (1) lithium; (2) sodium; (3) potassium; (4) rubidium.
- ___ 92. Which particle has the greatest mass? (1) an alpha particle; (2) a beta particle; (3) an electron; (4) a neutron.
- ___ 93. Which electron transition results in the emission of energy? (1) 2s to 2p; (2) 2p to 3s; (3) 3d to 2p; (4) 3p to 4d.
- ___ 94. Which radioisotope is used for diagnosing thyroid disorders? (1) Co^{60} ; (2) U^{238} ; (3) Pb^{206} ; (4) I^{131} .
- ___ 95. Cadmium and boron are commonly used in a nuclear reactor as (1) external shielding; (2) internal shielding; (3) control rods; (4) moderators.
- ___ 96. A radioactive isotope has a half-life of 10 years. What fraction of the original mass will remain unchanged after 50 years? (1) 1/2; (2) 1/8; (3) 1/16; (4) 1/32.
- ___ 97. Which emission from a radioactive source is not affected by an electric field? (1) alpha particles; (2) beta particles; (3) positrons; (4) gamma rays.
- ___ 98. From which sublevel or sublevels can an atom of Fe lose electrons when forming the Fe^{3+} ion? (1) the 4d, only; (2) the 3p, only; (3) both the 3d and 4s; (4) both the 3s and 4d.
- ___ 99. As an atom in the excited state returns to the ground state then the energy of the atom (1) decreases; (2) increases; (3) remains the same.
- ___ 100. If n represents the principal energy level then the maximum number of electrons possible in that principal energy level is equal to (1) n; (2) 2n; (3) n^2 ; (4) $2n^2$.
- ___ 101. Which of the following particles has the least mass? (1) alpha particle; (2) beta particle; (3) proton; (4) neutron.
- ___ 102. The element in Period 2 with the highest first ionization energy is (1) a noble gas; (2) a halogen; (3) an alkali metal; (4) an alkaline earth metal.
- ___ 103. The greatest absorption of energy occurs as an electron moves from (1) 1s to 3s; (2) 3p to 3s; (3) 4d to 4s; (4) 4s to 3p.
- ___ 104. Which particle has a negative charge? (1) alpha particle; (2) beta particle; (3) proton; (4) neutron.
- ___ 105. The amount of energy required to remove the most loosely bound electron from an atom in the gaseous phase is called (1) kinetic energy; (2) potential energy; (3) ionization energy; (4) electron affinity.
- ___ 106. What is the total number of electrons in an atom with an atomic number of 13 and

a mass number of 27? (1) 13; (2) 14; (3) 27; (4) 40.

- ___ 107. Which atom in the ground state contains only one orbital that is partially occupied?
(1) Si; (2) Ne; (3) Ca; (4) Na.
- ___ 108. What is the maximum number of sublevels in the third principal energy level?
(1) 1; (2) 2; (3) 3; (4) 4.
- ___ 109. The number of valence electrons in an atom with an electron configuration $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$ is (1) 6; (2) 2; (3) 16; (4) 4.
- ___ 110. Which two particles have approximately the same mass? (1) neutron and electron;
(2) neutron and deuteron; (3) proton and neutron; (4) proton and electron.
- ___ 111. The element with atomic number 10 has an electron configuration that is the same
as (1) Na; (2) Na^{1+} ; (3) Cl; (4) Cl^{1-} .
- ___ 112. During which process would the ratio of U^{238} to Pb^{206} be used? (1) diagnosing
thyroid disorders; (2) dating geologic formations; (3) detecting brain tumors;
(4) treating cancer patients.
- ___ 113. Which substance may be used as both the coolant and moderator in a reactor?
(1) boron; (2) cadmium; (3) heavy water; (4) solid graphite.
- ___ 114. An isotope of which element may be used as a fuel in a fission reaction? (1) hydrogen;
(2) carbon; (3) lithium; (4) plutonium.
- ___ 115. Which 1 mole sample of atoms requires the least energy to form a mole of positive
ions? (1) Ge; (2) Ca; (3) Ga; (4) K.
- ___ 116. The atomic number of an atom is always equal to the total number of (1) neutrons
in the nucleus; (2) protons in the nucleus; (3) neutrons plus protons in the atom;
(4) protons plus electrons in the atom.
- ___ 117. Which electron configuration represents an atom in the excited state?
(1) $1s^2, 2s^2, 2p^6, 3p^1$; (2) $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$; (3) $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$; (4) $1s^2, 2s^2, 2p^6, 3s^2$.
- ___ 118. Which principal energy level can hold a maximum of 18 electrons? (1) 5; (2) 2;
(3) 3; (4) 4.
- ___ 119. The total number of d orbitals in the third principal energy level is (1) 1; (2) 5;
(3) 3; (4) 7.
- ___ 120. What is the number of hours required for K^{42} to undergo 3 half-life periods
(half-life=12.4 hrs)? (1) 6.2 hours; (2) 12.4 hours; (3) 24.8 hours; (4) 37.2 hours.
- ___ 121. Usually the term "kernel" includes all parts of the atom except the (1) neutrons;
(2) protons; (3) valence electrons; (4) orbital electrons.
- ___ 122. Which nuclear emission moving through an electric field would be deflected toward
the positive electrode? (1) alpha particle; (2) beta particle; (3) gamma radiation;
(4) proton.
- ___ 123. What is the electron configuration for Be^{2+} ions? (1) $1s^1$; (2) $1s^2$; (3) $1s^2, 2s^1$;

(4) $1s^2, 2s^2$.

___ 124. Which particle can not be accelerated by the electric or magnetic fields in a particle accelerator? (1) neutron; (2) proton; (3) alpha particle; (4) beta particle.