Fundamentals of General, Organic, and Biological Chemistry, 7e **(McMurry)**
Chapter 2 Atoms and the Periodic Table

1) The smallest amount of an element that retains that element's characteristics is the
A) atom.
B) electron.
C) molecule.
D) neutron.
E) proton.
Answer: A
Diff: 1
Section: 2.1

2) Another name for atomic mass unit (amu) is the
A) avogadro.
B) dalton.
C) Kekule
D) kelvin.
E) mendeleev.
Answer: B
Diff: 1
Section: 2.1

3) Which characteristics correctly describe a proton?
A) approximate mass 1 amu; charge +1; inside nucleus
B) approximate mass 5×10^{-4} amu; charge -1; outside nucleus
C) approximate mass 5×10^{-4} amu; charge +1; inside nucleus
D) approximate mass 1 amu; charge 0; inside nucleus
E) approximate mass 1 amu; charge +1; outside nucleus
Answer: A
Diff: 1
Section: 2.1

4) Which particle has a mass approximately equal to the mass of a proton?
A) atom
B) electron
C) neutron
D) nucleus
E) quark
Answer: C
Diff: 1
Section: 2.1

5) Protons possess a _____ charge, and neutrons possess a _____ charge.
A) negative, negative
B) negative, positive
C) positive, negative
D) positive, zero
E) zero, positive
Answer: D
Diff: 1
Section: 2.1

6) Protons possess a _____ charge, and electrons possess a _____ charge.
A) negative, negative
B) negative, positive
C) positive, negative
D) positive, zero
E) zero, positive
Answer: C
Diff: 1
Section: 2.1

7) Which characteristics correctly describe a neutron?
A) approximate mass 1 amu; charge +1; inside nucleus
B) approximate mass 1 amu; charge -1; inside nucleus
C) approximate mass 1 amu; charge 0; inside nucleus
D) approximate mass 5×10^{-4} amu; charge 0; inside nucleus
E) approximate mass 5×10^{-4} amu; charge -1; outside nucleus
Answer: C
Diff: 1
Section: 2.1

8) Which characteristics correctly describe an electron?
A) approximate mass 1 amu; charge +1; inside nucleus
B) approximate mass 1 amu; charge -1; inside nucleus
C) approximate mass 1 amu; charge 0; inside nucleus
D) approximate mass 5×10^{-4} amu; charge 0; inside nucleus
E) approximate mass 5×10^{-4} amu; charge -1; outside nucleus
Answer: E
Diff: 1
Section: 2.1

9) In a neutral atom the number of _____ is equal to the number of _____.
A) protons, electrons
B) protons, neutrons
C) neutrons, electrons
D) protons + electrons, neutrons
E) none of the above
Answer: A
Diff: 1
Section: 2.1

10) Which statement is **incorrect** according to modern atomic theory?
A) Some sugars have the formula $C_{3.5}H_7O_{3.5}$.
B) An atom of ^{14}N has the same approximate mass as an atom of ^{14}C.
C) An atom of ^{14}N behaves differently in chemical reactions than an atom of ^{14}C.
D) An example of a chemical reaction is $CaCO_3 \rightarrow CaO + CO_2$.
E) C_2H_6 and C_3H_8 are both possible compounds of carbon and hydrogen.
Answer: A
Diff: 2
Section: 2.1

11) Where is most of the mass of an atom concentrated?
A) electrons
B) neutrons
C) nucleus
D) orbitals
E) protons
Answer: C
Diff: 2
Section: 2.1

12) An atom with Z = 26 and A = 58 contains _____ protons and _____ neutrons.
A) 26; 58
B) 58; 26
C) 26; 32
D) 32; 26
E) 26; 84
Answer: C
Diff: 1
Section: 2.2

13) An atom with Z = 35 and A = 80 contains _____ protons, _____ electrons, and _____ neutrons.
A) 35; 35; 80
B) 80; 35; 35
C) 35; 35; 45
D) 45; 80; 45
E) 45; 80; 35
Answer: C
Diff: 1
Section: 2.2

14) An atom containing 29 protons, 29 electrons, and 34 neutrons has a mass number of
A) 5.
B) 29.
C) 34.
D) 58.
E) 63.
Answer: E
Diff: 1
Section: 2.2

15) The atomic number of an atom containing 29 protons, 29 electrons, and 34 neutrons is
A) 5.
B) 29.
C) 34.
D) 58.
E) 63.
Answer: B
Diff: 1
Section: 2.2

16) An atom containing 47 protons, 47 electrons, and 60 neutrons has a mass number of
A) 13.
B) 47.
C) 60.
D) 107.
E) 154.
Answer: D
Diff: 1
Section: 2.2

17) The atomic number of an atom containing 47 protons, 47 electrons, and 60 neutrons is
A) 13.
B) 47.
C) 60.
D) 107.
E) 154.
Answer: B
Diff: 1
Section: 2.2

18) The value for Z for an atom containing 47 protons, 47 electrons, and 60 neutrons is
A) 13.
B) 47.
C) 60.
D) 107.
E) 154.
Answer: B
Diff: 1
Section: 2.2

19) The value of Z for the element ^{37}Ar is _____.
A) 37
B) 39.945
C) 19
D) 21.945
E) 18
Answer: E
Diff: 1
Section: 2.2

20) For the isotope ^{71}Ga, Z = _____ and A = _____.
A) 31; 40
B) 71; 31
C) 71; 40
D) 31; 71
E) 31; 69.723
Answer: D
Diff: 1
Section: 2.2

21) The mass number of Br-81 is _____.
A) 81
B) 79.904
C) 79
D) 46
E) 35
Answer: A
Diff: 1
Section: 2.2

22) How many neutrons does an atom of $^{46}_{22}\text{Ti}$ have?

A) 0
B) 22
C) 24
D) 46
E) 68
Answer: C
Diff: 2
Section: 2.2

23) Atoms of $^{35}_{17}\text{Cl}$ contain _____ protons and _____ electrons.

A) 17; 17
B) 17; 18
C) 18; 17
D) 35; 18
E) 35; 17
Answer: A
Diff: 2
Section: 2.2

24) An atom with a mass number of 58 and with 32 neutrons will have _____ protons.
A) 16
B) 26
C) 32
D) 58
E) 90
Answer: B
Diff: 2
Section: 2.2

25) The symbol of the element with 23 protons is
A) Mg.
B) Na.
C) V.
D) B.
E) none of the above
Answer: C
Diff: 2
Section: 2.2

26) An atom with Z = 31 and A = 69 contains _____ protons and _____ neutrons.
A) 31; 69
B) 69; 31
C) 31; 38
D) 38; 31
E) 31; 100
Answer: C
Diff: 2
Section: 2.2

27) The value of A for an atom containing 29 protons, 29 electrons, and 34 neutrons is
A) 5.
B) 29.
C) 34.
D) 58.
E) 63.
Answer: E
Diff: 2
Section: 2.2

28) The value of Z for an atom containing 29 protons, 29 electrons, and 34 neutrons, is
A) 5.
B) 29.
C) 34.
D) 58.
E) 63.
Answer: B
Diff: 2
Section: 2.2

29) The value for A for an atom containing 47 protons, 47 electrons, and 60 neutrons is
A) 13.
B) 47.
C) 60.
D) 107.
E) 154.
Answer: D
Diff: 2
Section: 2.2

30) The number of neutrons in an atom is equal to:
A) atomic number - mass number
B) mass number - atomic number
C) the atomic number
D) the mass number
Answer: B
Diff: 2
Section: 2.2

31) An atom that contains 47 protons, 47 electrons, and 60 neutrons is an isotope of
A) Ag.
B) Al.
C) Nd.
D) Bh.
E) cannot be determined from the information given
Answer: A
Diff: 2
Section: 2.2

32) Atoms of $^{35}_{17}\text{Cl}$ contain _____ protons and _____ neutrons.

A) 17; 17
B) 17; 18
C) 18; 17
D) 35; 18
E) 35; 17
Answer: B
Diff: 2
Section: 2.2

33) An isotope with 15 protons and 17 neutrons will have which symbol?

A) $^{32}_{17}\text{Cl}$

B) $^{17}_{15}\text{Cl}$

C) $^{32}_{15}\text{P}$

D) $^{32}_{17}\text{P}$

E) $^{17}_{15}\text{P}$

Answer: C
Diff: 2
Section: 2.2

34) Consider the isotope $^{79}_{35}\text{Br}$. The atomic number is _____, and the mass number is _____.

A) 79; 35
B) 35; 79
C) 44; 35
D) 35; 44
E) 35; 114
Answer: B
Diff: 2
Section: 2.2

35) Cobalt is element 27. Cobalt-60 is used in the medical treatment of cancer. How many neutrons and protons are contained in the nucleus of this isotope?
A) 27 neutrons, 33 protons
B) 33 neutrons, 27 protons
C) 27 neutrons, 27 protons
D) 33 neutrons, 33 protons
Answer: B
Diff: 2
Section: 2.2

36) Hydrogen exists as three isotopes. These isotopes differ by the number of _____ contained in the atom.
A) neutrons
B) protons
C) electrons
D) charges
Answer: A
Diff: 2
Section: 2.3

37) Adding one proton to the nucleus of an atom
A) converts it to an isotope of the same element.
B) increases its atomic mass by one unit, but does not change its atomic number.
C) increases its atomic number by one unit but does not change its atomic mass.
D) does not change either its atomic number or its atomic mass.
E) converts it to an atom of a different element.
Answer: E
Diff: 1
Section: 2.3

38) Adding one neutron to the nucleus of an atom
A) converts it to an isotope of the same element.
B) increases its atomic mass by two units, but does not change its atomic number.
C) increases its atomic number by one unit but does not change its atomic mass.
D) does not change either its atomic number or its atomic mass.
E) converts it to an atom of a different element.
Answer: A
Diff: 1
Section: 2.3

39) Naturally occurring iron contains 5.82% ^{54}Fe, 91.66 % ^{56}Fe, 2.19% ^{57}Fe, and 0.33% ^{58}Fe. The respective atomic masses are 53.940 amu, 55.935 amu, 56.935 amu, and 57.933 amu. Calculate the average atomic mass of iron.
Answer: 55.847 amu.
Diff: 2
Section: 2.3

40) An imaginary element Xq consists of two isotopes having masses of 100.0 amu and 102.0 amu. A sample of Xq was found to contain 20.0% of the ^{100}Xq isotope and 80.0% of the ^{102}Xq. Calculate the atomic weight of Xq.
A) 100.2 amu
B) 100.4 amu
C) 101.0 amu
D) 101.6 amu
E) 202.0 amu
Answer: D
Diff: 3
Section: 2.3

41) An imaginary element Xz consists of two isotopes having masses of 100.0 amu and 102.0 amu. A sample of Xz was found to contain 75.0% of the ^{100}Xz isotope and 25.0% of the ^{102}Xz. Calculate the atomic weight of Xz.
A) 100.3 amu
B) 100.5 amu
C) 101.0 amu
D) 101.5 amu
E) 101.8 amu
Answer: B
Diff: 3
Section: 2.3

42) Which of the following represents a pair of isotopes?
A) $^{14}_{6}$C, $^{14}_{7}$N
B) $^{1}_{1}$H, $^{2}_{1}$H
C) $^{32}_{16}$S, $^{32}_{16}$S^{-2}
D) O_2, O_3
Answer: B
Diff: 3
Section: 2.3

43) Which elements all belong in the same group?
A) C, N, O
B) Fe, Cu, Ni
C) B, Si, As
D) F, Cl, Br
E) Al, Ge, Sb
Answer: D
Diff: 1
Section: 2.4

44) Elements in the Periodic Table are arranged according to
A) alphabetical order.
B) atomic number.
C) atomic weight.
D) date of discovery.
E) number of neutrons.
Answer: B
Diff: 1
Section: 2.4

45) Which element is most likely to have chemical properties similar to those of potassium (atomic number 19)?
A) Ar (atomic number 18)
B) Ca (atomic number 20)
C) Sc (atomic number 21)
D) Rb (atomic number 37)
E) Sr (atomic number 38)
Answer: D
Diff: 2
Section: 2.4

46) Which element is **not** a semimetal?
A) Al
B) Si
C) Ge
D) As
E) none of the above
Answer: A
Diff: 2
Section: 2.4

47) Which group of elements contains only non-metals?
A) Mg, Ca, Sr
B) V, Cr, Mn
C) Cl, Ar, K
D) P, As, Se
E) C, S, I
Answer: E
Diff: 1
Section: 2.4

48) Which of the following is an alkali metal?
A) Al
B) Cl
C) He
D) Na
E) O
Answer: D
Diff: 1
Section: 2.5

49) Magnesium is an example of a(an)
A) alkali metal.
B) alkaline earth.
C) halogen.
D) noble gas.
E) transition metal.
Answer: B
Diff: 1
Section: 2.5

50) Which of the following elements is a noble gas?
A) Cl
B) H
C) N
D) Ne
E) O
Answer: D
Diff: 1
Section: 2.5

51) Which group contains only metalloids?
A) Ni, Pd, Pt
B) Si, Ge, As
C) Ce, Pr, Nd
D) Kr, Xe, Rn
E) Po, Fr, Ac
Answer: B
Diff: 1
Section: 2.5

52) Which group contains only noble gases?
A) Ni, Pd, Pt
B) Si, Ge, As
C) Ce, Pr, Nd
D) Kr, Xe, Rn
E) Po, Fr, Ac
Answer: D
Diff: 1
Section: 2.5

53) Which column of the periodic table contains only nonmetals?
A) 4A
B) 5A
C) 6A
D) 7A
Answer: D
Diff: 1
Section: 2.5

54) Which element is most likely to have chemical properties similar to those of bromine (atomic number 35)?
A) S (atomic number 16)
B) Se (atomic number 34)
C) Kr (atomic number 36)
D) Te (atomic number 52)
E) I (atomic number 53)
Answer: E
Diff: 2
Section: 2.5

55) The maximum number of electrons in any orbital is _____.
A) 1
B) 2
C) 3
D) 4
E) 5
Answer: B
Diff: 1
Section: 2.6

56) How many electrons can occupy the shell having n = 2?
A) 2
B) 6
C) 8
D) 18
E) 32
Answer: C
Diff: 1
Section: 2.6

57) How many electrons can occupy the shell having n = 4?
A) 2
B) 8
C) 10
D) 18
E) 32
Answer: E
Diff: 1
Section: 2.6

58) How many electrons can occupy the 4s subshell?
A) 1
B) 2
C) 6
D) 8
E) 10
Answer: B
Diff: 1
Section: 2.6

59) How many electrons can occupy the 4d subshell?
A) 1
B) 2
C) 6
D) 8
E) 10
Answer: E
Diff: 1
Section: 2.6

60) What is the maximum number of electrons that can occupy the 4f orbitals?
A) 2
B) 6
C) 8
D) 10
E) 14
Answer: E
Diff: 1
Section: 2.6

61) What is the maximum number of electrons that can occupy the 3d orbitals?
A) 2
B) 6
C) 8
D) 10
E) 14
Answer: D
Diff: 1
Section: 2.6

62) At maximum, an *f* subshell can hold _____ electrons, a *d* subshell can hold _____ electrons and a *p* subshell can hold _____ electrons.
A) 14, 10, 6
B) 2, 8, 18
C) 18, 8, 2
D) 2, 12, 21
E) 14, 6, 10
Answer: A
Diff: 1
Section: 2.6

63) The electron capacity of the third shell is _____.
A) 8
B) 10
C) 18
D) 24
E) 32
Answer: C
Diff: 2
Section: 2.6

64) Which of the following subshells consists of three orbitals?
A) 4s
B) 4p
C) 4d
D) 4f
E) none of the above
Answer: B
Diff: 2
Section: 2.6

65) Which of the following subshells consists of five orbitals?
A) 4s
B) 4p
C) 4d
D) 4f
E) none of the above
Answer: C
Diff: 2
Section: 2.6

66) The shell having n = 2 contains _____ subshells, _____ orbitals, and up to _____ electrons.
A) 1, 2, 4
B) 2, 4, 8
C) 3, 6, 12
D) 4, 8, 16
E) none of the above
Answer: B
Diff: 3
Section: 2.6

67) The shell having n = 3 contains _____ subshells, _____ orbitals, and up to _____ electrons
A) 2, 4, 8
B) 3, 6, 12
C) 3, 6, 18
D) 3, 9, 18
E) 3, 12, 36
Answer: D
Diff: 3
Section: 2.6

68) Explain the term "quantized" as it applies to the energy of electrons. (Optional: Be sure to include an example that has not been previously mentioned of something that is quantized.)
Answer: The term "quantized" means that their electrons can only have certain values of energy. This leads to the idea of definite orbitals, instead of allowing the electrons to be at any location within the atom. Examples can be things that are counted, but cannot be split into smaller parts. The price of a candy bar is quantized□it cannot be 39.446 cents□it is either 39 cents or 40 cents.
Diff: 2
Section: 2.6

69) What is the electron configuration of S?
A) $1s^2\ 2s^2\ 2p^2$
B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$
C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
E) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$
Answer: C
Diff: 2
Section: 2.7

70) What is the electron configuration of Mg?
A) $1s^2\ 2s^2\ 2p^8$
B) $1s^2\ 2s^2\ 2p^6\ 3s^2$
C) $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p^3$
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$
E) none of the above
Answer: B
Diff: 2
Section: 2.7

71) The element with the electron configuration $1s^2\ 2s^2\ 2p^4$ is _____.
A) Be
B) C
C) O
D) Si
E) S
Answer: C
Diff: 2
Section: 2.7

72) What is the electron configuration of Fe?
A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$
B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$
C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4p^6$
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
E) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$
Answer: B
Diff: 2
Section: 2.7

73) The ground state electron configuration for nickel is
A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$.
B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 4s^2\ 3d^{10}\ 4p^4$.
C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4d^8$.
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$.
Answer: D
Diff: 3
Section: 2.7

74) The element with the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ is
A) fluorine.
B) chlorine.
C) carbon.
D) potassium.
E) sulfur.
Answer: B
Diff: 2
Section: 2.7

75) An element with the same number of valence electrons as the element with the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ is
A) iodine.
B) oxygen.
C) argon.
D) potassium.
E) sulfur.
Answer: A
Diff: 2
Section: 2.7

76) The element with the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$ is
A) Rb.
B) Ar.
C) Ca.
D) K.
E) Mg.
Answer: D
Diff: 2
Section: 2.7

77) The number of valence electrons in an element with electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$ is _____.
A) 2
B) 4
C) 6
D) 8
E) 16
Answer: C
Diff: 2
Section: 2.7

78) The correct order for filling orbitals with electrons is _____.
A) 1s, 2s, 2p, 3s, 3d, 4s, 3p
B) 1s, 2s, 3s, 4s, 2p, 3p, 3d
C) 1s, 2s, 2p, 3s, 3p, 4s, 3d
D) 1s, 2s, 3d, 2p, 3p, 3s, 4s
Answer: C
Diff: 2
Section: 2.7

79) The electron configuration for phosphorus is
A) $1s^2\ 1p^6\ 2s^2\ 2p^5$.
B) $1s^2\ 2s^2\ 2p^6\ 3p^5$.
C) $1s^2\ 2s^2\ 2p^6\ 3s^4\ 3p^1$.
D) $2s^2\ 2p^6\ 3s^2\ 3p^5$.
E) $1s^2 2s^2 2p^6 3s^2 3p^3$.
Answer: E
Diff: 3
Section: 2.7

80) Which group contains only f-block elements?
A) Ni, Pd, Pt
B) Si, Ge, As
C) Ce, Pr, Nd
D) Kr, Xe, Rn
E) Po, Fr, Ac
Answer: C
Diff: 1
Section: 2.8

81) Which group contains only d-block elements?
A) Ni, Pd, Pt
B) Si, Ge, As
C) Ce, Pr, Nd
D) Kr, Xe, Rn
E) Po, Fr, Ac
Answer: A
Diff: 1
Section: 2.8

82) Which group contains only p-block elements?
A) N, S, Br
B) Mn, Cu, Ag
C) K, Mg, Al
D) Ce, Pr, Nd
Answer: A
Diff: 1
Section: 2.8

83) Transition metals can also be called
A) s-block elements.
B) p-block elements.
C) d-block elements.
D) f-block elements.
E) precious metals.
Answer: C
Diff: 1
Section: 2.8

84) The number of valence electrons in a main group element is given by _____.
A) the element's atomic number
B) the element's atomic weight
C) the element's group number
D) none of the above
Answer: C
Diff: 1
Section: 2.8

85) Valence electrons in the main group elements are contained in which type(s) of orbitals?
A) *s*
B) *p*
C) s and *p*
D) *d*
Answer: C
Diff: 1
Section: 2.8

86) How many electrons are there in the valence shell of a nitrogen atom?
A) 0
B) 2
C) 3
D) 5
E) 7
Answer: D
Diff: 2
Section: 2.8

87) An s-block element in the 5th Period is
A) Y.
B) As.
C) Sr.
D) Mo.
E) Ag.
Answer: C
Diff: 2
Section: 2.8

88) The element which has four valence electrons is _____.
A) H
B) Na
C) Mg
D) Si
E) S
Answer: D
Diff: 2
Section: 2.8

89) An element with 2 valence electrons is _____.
A) Se
B) Si
C) Ca
D) Rb
Answer: C
Diff: 2
Section: 2.8

90) In terms of atomic structure, the common characteristic of elements in the same group is
A) number of electrons.
B) number of electrons in the outermost shell.
C) number of neutrons.
D) number of protons.
E) none of the above
Answer: B
Diff: 3
Section: 2.8

91) Explain how the term "valence electrons" is related to electron configurations. Use the elements in group VI, Periods, 3, 4, and 5, as examples.
Answer: The electron configuration allows us to determine the number of valence electrons by identifying the orbitals in the outermost shell so their electrons can be counted. The orbitals in the outermost shell are all those with the largest coefficient. For example, the electron configuration of S is $1s^2 2s^2 2p^6 3s^2 3p^4$. The outermost orbitals, which have a coefficient of 3, contain six electrons. Therefore sulfur has six valence electrons. For Se, the electron configuration is $[Ar]4s^2 3d^{10} 4p^4$, and the orbitals with the largest coefficient (4) contain six electrons. Selenium has six valence electrons. Likewise, for Te, the electron configuration is $[Kr]\ 5s^2 4d^{10} 5p^4$, and the orbitals with the largest coefficient (5) contain a total of six electrons, the valence electrons.
Diff: 3
Section: 2.8