***Chemistry: A Molecular Approach, Second Cdn. Ed.* (Tro)**
Chapter 2 Atoms and Elements

2.1 Multiple Choice Questions

1) In a chemical reaction, matter is neither created nor destroyed. Which law does this refer to?
A) Law of definite proportions
B) Law of the conservation of mass
C) Law of modern atomic theory
D) Law of multiple proportions
E) First law of thermodynamics
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

2) If 3.6 g of chlorine combines with sodium to make 6.0 g of sodium chloride, what mass of sodium is required?
A) 3.6 g
B) 2.4 g
C) 6.0 g
D) 9.6 g
E) 1.2 g
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.3

3) What mass of calcium is required to produce 4.2 g of calcium bromide, starting with 3.4 g of bromine?
A) 0.4 g
B) 3.4 g
C) 4.2 g
D) 1.6 g
E) 0.8 g
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.3

4) All samples of a given compound, regardless of their source or how they were prepared, have the same proportions of their constituent elements. Which law does this refer to?
A) Law of definite proportions
B) Law of the conservation of mass
C) Law of modern atomic theory
D) Law of multiple proportions
E) First law of thermodynamics
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

5) If 26.0 g of water, H_2O, is found to contain 2.9 g of hydrogen and 23.1 g of oxygen, how much hydrogen and oxygen, in grams, is contained in 32.0 g of water?
A) 3.6 g hydrogen and 28.4 g oxygen
B) 28.4 g hydrogen and 3.6 g oxygen
C) 26.0 g hydrogen and 28.4 g oxygen
D) 3.6 g hydrogen and 2.9 g oxygen
E) 2.9 g hydrogen and 28.4 g oxygen
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.3

6) When two elements, A and B, form two different compounds, the masses of element B that combine with 1 g of element A can be expressed as a ratio of small whole numbers. Which law does this refer to?
A) Law of definite proportions
B) Law of the conservation of mass
C) Law of modern atomic theory
D) Law of multiple proportions
E) First law of thermodynamics
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

7) If 6.0 g of carbon combines with 16.0 g of oxygen to form 22.0 g of carbon dioxide, how much carbon and oxygen, in grams, is in 28.7 g carbon dioxide?
A) 20.9 g carbon and 7.8 g oxygen
B) 20.9 g carbon and 10.5 g oxygen
C) 7.8 g carbon and 20.9 g oxygen
D) 7.8 g carbon and 10.5 g oxygen
E) 3.9 g carbon and 20.9 g oxygen
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.3

8) Dalton's atomic theory states
A) that all elements have several isotopes.
B) that matter is composed of small indestructible particles.
C) that the properties of matter are determined by the properties of atoms.
D) that energy is neither created nor destroyed during a chemical reaction.
E) that an atom is predominantly empty space.
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

9) Which of the following is an example of the law of multiple proportions?
A) A sample of chlorine is found to contain three times as much Cl-35 as Cl-37.
B) Two different compounds formed from carbon and oxygen have the following mass ratios: 1.33 g O:1 g C and 2.66 g O:1 g C.
C) Two different samples of table salt are found to have the same ratio of sodium to chlorine.
D) The atomic mass of bromine is found to be 79.90 amu.
E) Nitrogen dioxide always has a mass ratio of 2.28 g O:1 g N.
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

10) Which of the following statements is TRUE according to Dalton's atomic theory?
A) Atoms combine in simple fraction ratios to form compounds.
B) All atoms of chlorine have identical properties to other elements with similar mass.
C) Atoms of carbon can be changed into atoms of oxygen when creating carbon dioxide.
D) Atoms of carbon do not change into another element during a chemical reaction with chlorine.
E) An atom of nitrogen can be broken down into smaller particles that will still have the unique properties of nitrogen.
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.3

11) Identify the description of an atom.
A) neutrons and electrons in nucleus; protons in orbitals
B) neutrons in nucleus; protons and electrons in orbitals
C) protons and neutrons in nucleus; electrons in orbitals
D) protons and electrons in nucleus; neutrons in orbitals
E) electrons in nucleus; protons and neutrons in orbitals
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

12) Identify the charges of protons, neutrons, and electrons.
A) protons +1, neutrons 0, electrons -1
B) protons 0, neutrons -1, electrons +1
C) protons -1, neutrons 0, electrons +1
D) protons 0, neutrons +1, electrons -1
E) protons +1, neutrons -1, electrons 0
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

13) Isotopes differ in the number of what particle?
A) beta particles
B) protons
C) electrons
D) neutrons
E) gamma particles
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

14) The mass number is equal to
A) the sum of the number of the electrons and protons.
B) the sum of the number of the neutrons and electrons.
C) the sum of the number of protons, neutrons, and electrons.
D) the sum of the number of protons and neutrons.
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

15) Identify the element that has an atomic number of 40.
A) neon
B) calcium
C) zirconium
D) bromine
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

16) What does "X" represent in the following symbol?

$$^{80}_{35}\text{X}$$

A) mercury
B) chlorine
C) scandium
D) bromine
E) selenium
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

17) What does "X" represent in the following symbol?

$$^{28}_{14}\text{X}$$

A) silicon
B) sulfur
C) zinc
D) ruthenium
E) nickel
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

18) What does "X" represent in the following symbol?

$$^{235}_{92}\text{X}$$

A) tin
B) copper
C) palladium
D) niobium
E) uranium
Answer: E
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

19) Determine the number of protons, neutrons, and electrons in the following:

$$^{40}_{18}\text{X}$$

A) $p^+ = 18$ $n° = 18$ $e^- = 22$
B) $p^+ = 18$ $n° = 22$ $e^- = 18$
C) $p^+ = 22$ $n° = 18$ $e^- = 18$
D) $p^+ = 18$ $n° = 22$ $e^- = 40$
E) $p^+ = 40$ $n° = 22$ $e^- = 18$
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

20) Determine the number of protons, neutrons, and electrons in the following:

$$^{25}_{12}\text{X}$$

A) $p^+ = 12$ $n° = 25$ $e^- = 12$
B) $p^+ = 12$ $n° = 12$ $e^- = 13$
C) $p^+ = 12$ $n° = 13$ $e^- = 12$
D) $p^+ = 25$ $n° = 12$ $e^- = 13$
E) $p^+ = 12$ $n° = 13$ $e^- = 25$
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

21) Determine the number of protons, neutrons, and electrons in the following:

$^{65}_{29}X$

A) $p^+ = 36$ $n° = 29$ $e^- = 36$
B) $p^+ = 29$ $n° = 29$ $e^- = 36$
C) $p^+ = 36$ $n° = 36$ $e^- = 29$
D) $p^+ = 29$ $n° = 36$ $e^- = 29$
E) $p^+ = 29$ $n° = 36$ $e^- = 36$
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

22) What element is defined by the following information?

$p^+ = 11$ $n° = 12$ $e^- = 11$

A) sodium
B) vanadium
C) magnesium
D) titanium
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

23) What element is defined by the following information?

$p^+ = 20$ $n° = 20$ $e^- = 20$

A) zirconium
B) calcium
C) potassium
D) neon
E) argon
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

24) What element is defined by the following information?

$p^+ = 17$ $n^\circ = 20$ $e^- = 17$

A) calcium
B) rubidium
C) chlorine
D) neon
E) oxygen
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

25) How many electrons are in arsenic?
A) 33
B) 41
C) 42
D) 41.9
E) 75
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

26) How many neutrons are in arsenic-42?
A) 33
B) 41
C) 9
D) 41.9
E) 75
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

27) How many protons are in arsenic?
A) 33
B) 41
C) 42
D) 41.9
E) 75
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

28) Which of the following statements about subatomic particles is TRUE?
A) A neutral atom contains the same number of protons and electrons.
B) Protons have about the same mass as electrons.
C) Electrons make up most of the mass of an atom.
D) Protons and neutrons have opposite, but equal in magnitude, charges.
E) Neutrons and electrons are found in the nucleus of an atom.
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

29) Isotopes differ in the number of
A) protons.
B) neutrons.
C) electrons.
D) neutrons and electrons.
E) protons and electrons.
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

30) Which of the following statements about isotopes is TRUE?
A) Isotopes of the same element differ only in the number of electrons they contain.
B) An isotope of an atom with a larger number of neutrons is larger than an isotope of the same atom that contains fewer neutrons.
C) Isotopes of the same element have the same mass.
D) Isotopes of the same element don't usually have the same properties.
E) Some elements have three or more naturally occurring isotopes.
Answer: E
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

31) Identify the symbol for fluorine.
A) F
B) Fl
C) Fo
D) Fu
E) Fr
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

32) Identify the symbol for silver.
A) S
B) Si
C) Ar
D) Ag
E) Sl
Answer: D
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

33) Identify a cation.
A) An atom that has lost (an) electron(s).
B) An atom that has gained (an) electron(s).
C) An atom that has lost (a) proton(s).
D) An atom that has gained (a) proton(s).
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

34) What species is represented by the following information?

$p^+ = 12$ $n° = 14$ $e^- = 10$

A) Si^{4+}
B) Mg
C) Ne
D) Si
E) Mg^{2+}
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

35) What species is represented by the following information?

$p^+ = 47$ $n° = 62$ $e^- = 46$

A) Ag^+
B) Nd
C) Pd
D) Ag
E) Pd^+
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

36) What species is represented by the following information?

$p^+ = 17$ $n° = 18$ $e^- = 18$

A) Cl
B) Cl^-
C) Ar
D) Ar^+
E) Kr
Answer: B
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

37) Predict the charge that an aluminum ion would have.
A) 5-
B) 1+
C) 1-
D) 2+
E) 3+
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.4

38) Predict the charge that a calcium ion would have.
A) 6-
B) 2-
C) 3+
D) 2+
E) 1+
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.4

39) Predict the charge that an ion formed from sulfur would have.
A) 1-
B) 6+
C) 3-
D) 4+
E) 2-
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.4

40) Predict the charge that an ion formed from bromine would have.
A) 1-
B) 2+
C) 1+
D) 4+
E) 2-
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.4

41) Identify the number of neutrons in P^{-3}. Phosphorus has one stable isotope, phosphorus-31.
A) 18
B) 12
C) 19
D) 15
E) 16
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

42) Identify the number of electrons in P^{-3}.
A) 18
B) 12
C) 19
D) 15
E) 16
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

43) Identify the number of protons in P^{-3}.
A) 18
B) 12
C) 19
D) 15
E) 16
Answer: D
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

44) What is the atomic number for tin?
A) 47.87
B) 50
C) 118.71
D) 22
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.4

45) Identify the largest by size atom or ion of carbon.
A) $p^+ = 6$ $n° = 6$ $e^- = 6$
B) $p^+ = 6$ $n° = 7$ $e^- = 6$
C) $p^+ = 6$ $n° = 6$ $e^- = 7$
D) $p^+ = 6$ $n° = 6$ $e^- = 5$
Answer: C
Diff: 2 Type: MC Var: 1 Page Ref: 2.4

46) What is the atomic mass for cadmium?
A) 48
B) 112.41
C) 40.08
D) 20
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.5

47) What is the atomic mass for tin?
A) 47.87
B) 50
C) 118.71
D) 22
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.5

48) Calculate the atomic mass of silver if silver has two naturally occurring isotopes with the following masses and natural abundances:

Ag-107	106.90509 u	51.84%
Ag-109	108.90476 u	48.46%

A) 107.90 u
B) 108.00 u
C) 107.79 u
D) 108.32 u
E) 108.19 u
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.5

49) Calculate the atomic mass of gallium if gallium has two naturally occurring isotopes with the following masses and natural abundances:

Ga-69	68.9256 u	60.11%
Ga-71	70.9247 u	39.89%

A) 69.72 u
B) 69.93 u
C) 70.00 u
D) 69.80 u
E) 70.68 u
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.5

50) Silver has an atomic mass of 107.868 u. The Ag-109 isotope (108.905 u) has an abundance of 48.161%. What is the atomic mass, in u, of the other isotope?
A) 106.905 u
B) 106.908 u
C) 106.903 u
D) 106.911 u
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

51) Carbon has two naturally occurring isotopes, carbon-12 and carbon-13. The more common isotope of carbon is carbon-12 with an abundance of 98.93% while carbon-13 has an atomic mass of 13.00335 u. Calculate the atomic mass of carbon-12 if the atomic mass of carbon is 12.0107 u.
A) 13.1 u
B) 13.0 u
C) 12.0 u
D) 12.8 u
E) 12.4 u
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

52) Zinc has five naturally occurring isotopes, Zn-64, Zn-66, Zn-67, Zn-68 and Zn-70. Calculate the atomic mass of zinc given the following abundances and atomic masses for the isotopes:

Zn-64	63.9291 u	48.61%
Zn-66	65.9260 u	27.9%
Zn-67	66.9271 u	4.1%
Zn-68	67.9248 u	18.75%
Zn-70	69.9253 u	0.62%

A) 66.3 u
B) 65.4 u
C) 66.7 u
D) 65.1 u
E) 64.8 u
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

53) Gallium has an atomic mass of 69.723 u. The abundance of Ga-69 (68.926 u) is 60.11%. What is the atomic mass, in u, of the other isotope?
A) 70.92 u
B) 70.93 u
C) 70.94 u
D) 70.91 u
E) 70.930 u
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

54) Calculate the atomic mass of chromium if chromium has four naturally occurring isotopes with the following masses and natural abundances:

Cr-50	49.9461 u	4.35%
Cr-52	51.9405 u	83.79%
Cr-53	52.9407 u	9.50%
Cr-54	53.9389 u	2.36%

A) 51.94 u
B) 51.69 u
C) 208.7 u
D) 53.21 u
E) 52.00 u
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

55) Cerium has four stable isotopes listed below. If the weighted average atomic mass of cerium is 140.116 u, calculate the atomic mass of cerium-142.

Ce-136	135.90714 u	0.19%
Ce-138	137.90599 u	0.25%
Ce-140	139.90543 u	88.43%
Ce-142		11.13%

A) 141.911 u
B) 142.617 u
C) 140.334 u
D) 142.501 u
E) 139.886 u
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

56) Bromine has two naturally occurring isotopes, Br-79 and Br-81. The mass of Br-79 is 78.92 u with a percent abundance of 50.69%. If the atomic mass of bromine is 79.904 u, calculate the mass and percent abundance of Br-81.

A) 80.916 u and 50.69%
B) 78.921 u and 49.31%
C) 79.904 u and 49.31%
D) 80.916 u and 49.31%
E) 80.028 u and 50.31%
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

57) Bromine has two naturally occurring isotopes, Br-79 and Br-81. The atomic mass of Br-79 is 78.9183 u with a percent abundance of 50.69% and the atomic mass of Br-81 is 80.9163 u. Calculate the atomic mass of bromine.
A) 80.91 u
B) 78.92 u
C) 79.90 u
D) 80.92 u
E) 80.03 u
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

58) Calculate the atomic mass of tungsten given the atomic mass and percent abundance for the following isotopes:

W-180	179.9467 u	0.12%
W-182	181.9482 u	26.50%
W-183	182.9502 u	14.31%
W-184	183.9509 u	30.64%
W-186	185.9544 u	28.43%

A) 183.75 u
B) 183.84 u
C) 182.98 u
D) 184.41 u
E) 183.92 u
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

59) The atomic mass of tungsten is 183.84 u. Given the following information for the mass and abundance of the other common isotopes, calculate the atomic mass of tungsten-186.

W-180	179.9467 u	0.12%
W-182	181.9482 u	26.50%
W-183	182.9502 u	14.31%
W-184	183.9509 u	30.64%
W-186		28.43%

A) 185.75 u
B) 186.48 u
C) 186.98 u
D) 184.41 u
E) 185.95 u
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

60) Calculate the atomic mass of element "X" if it has two naturally occurring isotopes with the following masses and natural abundances:

X-45	44.8776 u	32.88%
X-47	46.9443 u	67.12%

A) 46.26 u
B) 45.91 u
C) 46.34 u
D) 46.84 u
E) 44.99 u
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.5

61) In a 41.5 g sample of carbon, how many atoms have a mass of 12.0107 u?
A) 2.08×10^{24}
B) 3.00×10^{26}
C) 12
D) 1.2×10^{21}
E) 0
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

62) How many moles of fructose are in a sample containing 1.43×10^{24} molecules of fructose?
A) 1.16×10^{-48} mol
B) 0.420 mol
C) 8.61×10^{47} mol
D) 2.37 mol
E) 2.38×10^{-1} mol
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

63) Which of the following contains the <u>most</u> atoms? You shouldn't need to do a calculation here.
A) 10.0 g Ne
B) 10.0 g He
C) 10.0 g Ar
D) 10.0 g Kr
E) 10.0 g Mg
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.6

64) Which of the following contains the fewest atoms? You shouldn't need to do a calculation here.
A) 4.0 g Li
B) 4.0 g Na
C) 4.0 g Rb
D) 4.0 g K
E) 4.0 g Ca
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.6

65) How many silver atoms are contained in 3.75 moles of silver?
A) 6.23×10^{24} silver atoms
B) 2.26×10^{24} silver atoms
C) 1.61×10^{23} silver atoms
D) 2.44×10^{26} silver atoms
E) 6.50×10^{25} silver atoms
Answer: B
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

66) How many xenon atoms are contained in 2.36 moles of xenon?
A) 3.92×10^{24} xenon atoms
B) 2.55×10^{23} xenon atoms
C) 1.42×10^{24} xenon atoms
D) 7.91×10^{25} xenon atoms
E) 1.87×10^{26} xenon atoms
Answer: C
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

67) How many argon atoms are contained in 7.66×10^{5} mmol of argon?
A) 4.61×10^{26} Ar atoms
B) 1.84×10^{28} Ar atoms
C) 1.15×10^{28} Ar atoms
D) 7.86×10^{20} Ar atoms
E) 3.24×10^{26} Ar atoms
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

68) If 8.32 g of copper is mixed with 5.2372×10^{-2} mol of zinc to create the alloy brass, how many metal atoms total are present in the brass?
A) 7.88×10^{22} metal atoms
B) 3.04×10^{-25} metal atoms
C) 1.10×10^{23} metal atoms
D) 3.15×10^{22} metal atoms
E) 3.15×10^{-22} metal atoms
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

69) If 102.7 g of tin is mixed with 10.9 g of copper to create the alloy pewter, how many moles of metal are present in the pewter?
A) 0.9643 mol total
B) 1.037 mol total
C) 0.6233 mol total
D) 1.604 mol total
E) 0.8675 mol total
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

70) If 102.7 g of tin is mixed with 10.9 g of copper to create the alloy pewter, how many metal atoms total are present in the pewter?
A) 5.81×10^{23} metal atoms
B) 5.22×10^{23} metal atoms
C) 3.75×10^{23} metal atoms
D) 9.66×10^{23} metal atoms
E) 6.24×10^{23} metal atoms
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

71) How many dozen are in one mole?
A) 12 dozen
B) 6.0×10^{23} dozen
C) 2.0×10^{-23} dozen
D) 5.0×10^{22} dozen
E) 2.0×10^{23} dozen
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

72) How many moles are in one dozen?
A) 12 mol
B) 6.0×10^{23}mol
C) 2.0×10^{-23} mol
D) 5.0×10^{22} mol
E) 2.0×10^{23} mol
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

73) What mass (in g) does 3.99 moles of Kr have?
A) 334 g
B) 476 g
C) 211 g
D) 240 g
E) 144 g
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

74) How many atoms of chlorine are in 354.53 g of chlorine?
A) 6.02214×10^{-23}
B) 6.02214×10^{23}
C) 6.02214×10^{24}
D) 6.02214×10^{25}
E) 6.02214×10^{-24}
Answer: C
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

75) How many moles of potassium are contained in 449 g of potassium?
A) 11.5 moles
B) 17.6 moles
C) 69.2 moles
D) 23.9 moles
E) 41.5 moles
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

76) What is the average mass, in grams, of one atom of carbon?
A) 5.01×10^{-22} g
B) 5.01×10^{22} g
C) 1.38×10^{-25} g
D) 1.99×10^{-23} g
E) 1.99×10^{23} g
Answer: D
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

77) How many moles are in 2.16×10^{24} atoms of lead?
A) 35.9 moles
B) 3.59 moles
C) 0.359 moles
D) 6.08 moles
E) 1.79 moles
Answer: B
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

78) How many atoms are in 1.00 kg of copper?
A) 3.83×10^{29} atoms
B) 3.83×10^{22} atoms
C) 15.74 atoms
D) 2.61×10^{-23} atoms
E) 9.48×10^{24} atoms
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

79) How many atoms are in 2.50 moles of CO_2?
A) 4.52×10^{24} atoms
B) 1.52×10^{24} atoms
C) 5.02×10^{23} atoms
D) 3.01×10^{24} atoms
E) 7.53×10^{23} atoms
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

80) How many molecules are in 2.50 moles of CO_2?
A) 4.52×10^{24} molecules
B) 1.51×10^{24} molecules
C) 5.02×10^{23} molecules
D) 3.01×10^{24} molecules
E) 7.53×10^{23} molecules
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

81) What mass (in kg) does 5.84 moles of titanium (Ti) have?
A) 0.352 kg
B) 0.122 kg
C) 0.820 kg
D) 0.280 kg
E) 0.632 kg
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

82) What mass (in mg) does 2.63 moles of nickel have?
A) 44.8 mg
B) 2.23×10^{4} mg
C) 129 mg
D) 3.56×10^{5} mg
E) 1.54×10^{5} mg
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

83) How many moles of Kr are contained in 398 mg of Kr?
A) 4.75×10^{-3} moles Kr
B) 33.4 moles Kr
C) 2.11×10^{-4} moles Kr
D) 2.99×10^{-3} moles Kr
E) 1.19×10^{-4} moles Kr
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

84) How many moles of Cs are contained in 595 kg of Cs?
A) 2.23×10^{2} moles Cs
B) 4.48×10^{3} moles Cs
C) 7.91×10^{4} moles Cs
D) 1.26×10^{3} moles Cs
E) 5.39×10^{2} moles Cs
Answer: B
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

85) How many Li atoms are contained in 97.9 g of Li?
A) 5.90×10^{25} Li atoms
B) 7.09×10^{21} Li atoms
C) 8.49×10^{24} Li atoms
D) 4.27×10^{22} Li atoms
E) 4.18×10^{24} Li atoms
Answer: C
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

86) How many iron atoms are contained in 354 g of iron?
A) 2.62×10^{25} Fe atoms
B) 2.13×10^{26} Fe atoms
C) 4.69×10^{24} Fe atoms
D) 3.82×10^{24} Fe atoms
E) 9.50×10^{22} Fe atoms
Answer: D
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

87) What is the mass, in grams, of one mole of carbon?
A) 12.0107×10^{23} g
B) 1.99×10^{-23} g
C) 1.000 g
D) 5.01×10^{22} g
E) 12.0107 g
Answer: E
Diff: 1 Type: MC Var: 1 Page Ref: 2.6

88) How many phosphorus atoms are contained in 158 kg of phosphorus?
A) 3.07×10^{27} phosphorus atoms
B) 2.95×10^{27} phosphorus atoms
C) 3.25×10^{28} phosphorus atoms
D) 1.18×10^{24} phosphorus atoms
E) 8.47×10^{24} phosphorus atoms
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

89) Calculate the mass (in g) of 1.9×10^{24} atoms of Pb.
A) 3.9×10^{2} g
B) 2.4×10^{2} g
C) 3.2×10^{2} g
D) 1.5×10^{2} g
E) 6.5×10^{2} g
Answer: E
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

90) Calculate the mass (in kg) of 4.87×10^{25} atoms of Zn.
A) 5.29 kg
B) 1.89 kg
C) 8.09 kg
D) 1.24 kg
E) 1.09 kg
Answer: A
Diff: 3 Type: MC Var: 1 Page Ref: 2.6

91) Calculate the mass (in ng) of 2.33×10^{20} atoms of oxygen.
A) 6.19×10^{6} ng
B) 1.62×10^{7} ng
C) 2.25×10^{3} ng
D) 3.73×10^{6} ng
E) 4.69×10^{7} ng
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.6

92) Which of the following elements is a main-group metal?
A) Si
B) Sm
C) W
D) Pb
E) Ge
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

93) Which of the following elements is a metal?
A) As
B) C
C) I
D) Sn
E) Se
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

94) Which of the following elements is a nonmetal?
A) Zn
B) Cs
C) Ca
D) Co
E) P
Answer: E
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

95) Which of the following elements is a noble gas?
A) Ar
B) Br
C) N
D) O
E) K
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

96) Which of the following elements is a halogen?
A) Ne
B) I
C) O
D) Mg
E) K
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

97) Which of the following elements is an alkaline earth metal?
A) Cs
B) Cu
C) Mg
D) Ti
E) Br
Answer: C
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

98) Which of the following elements is an alkali metal?
A) Zn
B) Xe
C) F
D) Li
E) Ca
Answer: D
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

99) Which of the following elements is a metalloid?
A) Al
B) Ge
C) C
D) Sn
E) Gd
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

100) Which of the following is a transition element?
A) Pd
B) Sn
C) K
D) U
E) Pr
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

101) Which of the following statements is TRUE?
A) Halogens are very reactive metals.
B) The alkali metals are fairly reactive.
C) Sulfur is a transition-group element.
D) Noble gases readily form ionic compounds.
E) Zn is a main-group metal.
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

102) Which of the following describes a metal?
A) poor conductor of heat
B) good conductor of electricity
C) tends to gain electrons
D) forms ionic compounds with group 18 elements
E) found on the upper right corner of the periodic table
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

103) Which of the following describes a nonmetal?
A) tend to gain electrons
B) group 2 elements on the periodic table
C) good conductor of electricity
D) generally unreactive
E) good conductor of heat
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

104) Semiconductors are
A) metalloids.
B) noble gases.
C) nonmetals.
D) metals.
Answer: A
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

105) Which of the following statements is TRUE?
A) Cations are usually larger than their corresponding atom.
B) Metals tend to form cations.
C) Atoms are usually larger than their corresponding anion.
D) The halogens tend to form 1+ ions.
E) Nonmetals tend to lose electrons.
Answer: B
Diff: 1 Type: MC Var: 1 Page Ref: 2.7

106) When forming an ion, sulfur, S, will normally _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: B
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

107) When forming an ion, oxygen, O, will normally _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: B
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

108) When forming an ion, beryllium, Be, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

109) When forming an ion, calcium, Ca, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: E
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

110) When forming an ion, iodine, I, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

111) When forming an ion, fluorine, F, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: A
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

112) When forming an ion, rubidium, Rb, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: D
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

113) When forming an ion, sodium, Na, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: D
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

114) When forming the nitride ion, nitrogen, N, will _____ electron(s).
A) gain one
B) gain two
C) gain three
D) lose one
E) lose two
Answer: C
Diff: 2 Type: MC Var: 1 Page Ref: 2.7

2.2 Algorithmic Questions

1) An atom of ^{31}P contains _____ protons.
A) 15
B) 40
C) 22
D) 25
E) 31
Answer: A
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

2) An atom of ^{17}F contains _____ electrons.
A) 26
B) 8
C) 15
D) 9
E) 17
Answer: D
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

3) The atomic number of an atom of ^{80}Br is _____.
A) 115
B) 35
C) 45
D) 73
E) 80
Answer: B
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

4) An ion has 17 protons, 20 neutrons, and 18 electrons. The symbol for the ion is _____.
A) $^{37}Cl^-$
B) $^{37}Cl^+$
C) $^{38}S^+$
D) $^{38}S^-$
E) $^{37}S^{2+}$
Answer: A
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

5) How many electrons does the Ca^{2+} ion possess?
A) 27
B) 18
C) 9
D) 3
E) 20
Answer: B
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

6) How many protons does the I^- ion possess?
A) 52
B) 54
C) 4
D) 7
E) 53
Answer: E
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

7) Predict the charge of the most stable ion of chlorine.
A) 3+
B) 1-
C) 2-
D) 2+
E) 1+
Answer: B
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

8) Predict the charge of the most stable ion of sodium.
A) 2+
B) 3+
C) 1+
D) 2-
E) 1-
Answer: C
Diff: 1 Type: MC Var: 4 Page Ref: 2.4

9) What is the chemical symbol for titanium?
A) Th
B) Ti
C) Tl
D) Tm
Answer: B
Diff: 2 Type: MC Var: 5 Page Ref: 2.7

10) What is the chemical symbol for mercury?
A) Ag
B) Au
C) Hg
D) Pb
Answer: C
Diff: 2 Type: MC Var: 5 Page Ref: 2.7

11) What is the chemical symbol for copper?
A) Co
B) Cr
C) Cu
D) C
Answer: C
Diff: 2 Type: MC Var: 5 Page Ref: 2.7

12) Which element has the chemical symbol Ru?
A) rubidium
B) ruthenium
C) rutherfordium
D) rhodium
Answer: B
Diff: 2 Type: MC Var: 5 Page Ref: 2.7

13) Which element has the chemical symbol S?
A) selenium
B) silicon
C) sulfur
D) scandium
Answer: C
Diff: 2 Type: MC Var: 5 Page Ref: 2.7

14) An atom that has an atomic number of 20 and a mass number of 42 is an isotope of an atom that has
A) an atomic number of 21 and a mass number of 42.
B) an atomic number of 20 and a mass number of 40.
C) 22 neutrons and 20 protons.
D) 22 protons and 20 neutrons.
Answer: B
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

15) How many protons (p) and neutrons (n) are in an atom of $^{90}_{38}\text{Sr}$?

A) 38 p, 52 n
B) 38 p, 90 n
C) 52 p, 38 n
D) 90 p, 38 n
Answer: A
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

16) How many protons (p) and neutrons (n) are in an atom of barium-130?
A) 56 p, 74 n
B) 56 p, 130 n
C) 74 p, 56 n
D) 130 p, 56 n
Answer: A
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

17) What is the element symbol for an atom that has 5 protons and 6 neutrons?
A) B
B) C
C) H
D) Na
Answer: A
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

18) How many electrons are in a neutral atom of bromine-81?
A) 1
B) 35
C) 36
D) 81
Answer: B
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

19) Identify the chemical symbol of element Q in $^{80}_{34}\text{Q}$.

A) Br
B) Hg
C) Pd
D) Se
Answer: D
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

20) An atom of ^{82}Kr contains _____ neutrons.
A) 36
B) 118
C) 46
D) 80
E) 82
Answer: C
Diff: 2 Type: MC Var: 4 Page Ref: 2.4

21) The mass number of an atom of ^{67}Ga is _____.
A) 31
B) 76
C) 36
D) 67
E) 70
Answer: D
Diff: 2 Type: MC Var: 4 Page Ref: 2.4

22) What is the identity of element Q if the ion Q^{2+} contains 10 electrons?
A) C
B) O
C) Ne
D) Mg
Answer: D
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

23) How many electrons are in the ion Cu^{2+}?
A) 27
B) 29
C) 31
D) 64
Answer: A
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

24) How many electrons are in the ion P^{3-}?
A) 12
B) 18
C) 28
D) 34
Answer: B
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

25) In which of the following sets do all species have the same number of electrons?
A) F^-, Ne, Mg^{2+}
B) Ge, Se^{2-}, Br^-
C) K^+, Rb^+, Cs^+
D) Br, Br^-, Br^+
Answer: A
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

26) In which of the following sets do all species have the same number of protons?
A) Br^-, Kr, Sr^{2+}
B) C, N^{3-}, O^{2-}
C) Mg^{2+}, Sr^{2+}, Ba^{2+}
D) O, O^{2-}, O^{2+}
Answer: D
Diff: 2 Type: MC Var: 5 Page Ref: 2.4

27) Cesium belongs to the _____ group of the periodic table.
A) alkali metal
B) alkaline earth metal
C) halogen
D) noble gas
Answer: A
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

28) Iodine belongs to the _____ group of the periodic table.
A) alkali metal
B) alkaline earth metal
C) halogen
D) noble gas
Answer: C
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

29) Argon belongs to the _____ group of the periodic table.
A) alkali metal
B) alkaline earth metal
C) halogen
D) noble gas
Answer: D
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

30) Barium belongs to the _____ group of the periodic table.
A) alkali metal
B) alkaline earth metal
C) halogen
D) noble gas
Answer: B
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

31) Which of the following elements has chemical properties similar to tellurium?
A) fluorine
B) hydrogen
C) nitrogen
D) sulfur
Answer: D
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

32) Which of the following elements is a gas at room temperature?
A) bromine
B) carbon
C) helium
D) sodium
Answer: C
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

33) Which of the following elements is classified as a semimetal?
A) calcium
B) boron
C) fluorine
D) uranium
Answer: B
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

34) Which of the following elements is a good conductor of heat and electricity?
A) carbon
B) chlorine
C) neon
D) aluminum
Answer: D
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

35) Which one of the following elements is a poor conductor of heat and electricity?
A) copper
B) fluorine
C) iron
D) lead
Answer: B
Diff: 1 Type: MC Var: 5 Page Ref: 2.7

2.3 Matching Questions

Match the following.

A) C
B) Si
C) Fe
D) K
E) Mg

1) magnesium
Diff: 1 Type: MA Var: 1 Page Ref: 2.7

2) carbon
Diff: 1 Type: MA Var: 1 Page Ref: 2.7

3) potassium
Diff: 1 Type: MA Var: 1 Page Ref: 2.7

4) iron
Diff: 1 Type: MA Var: 1 Page Ref: 2.7

5) silicon
Diff: 1 Type: MA Var: 1 Page Ref: 2.7

Answers: 1) E 2) A 3) D 4) C 5) B

2.4 Short Answer Questions

1) Describe an atom and what it is made up of according to modern atomic theory.
Answer: An atom is made up of a nucleus surrounded by electrons. The nucleus contains protons (positively charged particles) and neutrons (neutral particles) and is where most of the mass of an atom comes from, but it is a tiny fraction of an atom's volume. The nucleus is surrounded by negatively charged electrons, the same number as there are protons in the nucleus. An atom is therefore neutral overall.
Diff: 2 Type: SA Var: 1 Page Ref: 2.3

2) The atomic number is equal to the number of _____.
Answer: protons
Diff: 1 Type: SA Var: 1 Page Ref: 2.4

3) Why do the isotopes of the same element have the same atomic size?
Answer: Isotopes only differ in the number of neutrons contained within the nucleus. Since the size of an atom is determined by the electrons, isotopes of the same element should be the same size.
Diff: 1 Type: SA Var: 1 Page Ref: 2.4

4) Why doesn't a mass spectrum of silver have a peak at 107.9 u?
Answer: The average atomic mass of silver is 107.9 u, but there are no atoms of silver that weigh 107.9 u. One isotope weighs more and another weighs less.
Diff: 1 Type: SA Var: 1 Page Ref: 2.5

5) Are anions typically larger or smaller than their corresponding atom? Why?
Answer: Anions are larger than their corresponding atom because the anion contains more electrons than the atom. Since electrons repel one another AND determine the size of the atom or ion, adding electrons to the atom to form an anion makes it larger.
Diff: 1 Type: SA Var: 1 Page Ref: 2.7

6) Give the name of the element whose symbol is Na.
Answer: sodium
Diff: 2 Type: SA Var: 1 Page Ref: 2.7

7) Describe the difference between ions and isotopes.
Answer: Ions are obtained by the loss or gain of electrons by the atoms, isotopes differ in the number of neutrons.
Diff: 2 Type: SA Var: 1 Page Ref: 2.4

8) Give an example of a halogen.
Answer: F, Br, I, Cl, or At
Diff: 1 Type: SA Var: 1 Page Ref: 2.7

9) What group of elements in the periodic table are the most unreactive and why?
Answer: The noble gases are the most unreactive because they do not combine with other elements to form compounds.
Diff: 1 Type: SA Var: 1 Page Ref: 2.7

10) Why do elements in the same group tend to have similar chemical properties?
Answer: Since elements in the same group have the same number of valence electrons (similar electron configurations) they tend to have similar chemical reactivity because chemical reactions typically involve valence electrons.
Diff: 1 Type: SA Var: 1 Page Ref: 2.7

11) Give the name of the instrument that is used to measure masses of atoms and the percent abundance of isotopes.
Answer: mass spectrometer
Diff: 2 Type: SA Var: 1 Page Ref: 2.5

12) The number 6.022×10^{23} is known as _____.
Answer: Avogadro's number
Diff: 1 Type: SA Var: 1 Page Ref: 2.6