

Chemistry: Structure & Properties, 2e (Tro)

Chapter 1: Atoms

1.1 Multiple Choice Questions

1) An element has three stable isotopes with masses of 27.977 amu, 28.976 amu, and 29.973 amu. The heavier two isotopes have an abundance of 4.68% and 3.09%, respectively. What is the mass of the element?

- A) 27.684 amu
- B) 29.251 amu
- C) 28.085 amu
- D) 30.107 amu
- E) 28.991 amu

Answer: C

Diff: 5 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

2) All of the following will lead to a homogeneous mixture EXCEPT

- A) sugar and coffee.
- B) mud and water.
- C) salt and water.
- D) ice tea and lemonade.
- E) vinegar and water.

Answer: B

Diff: 1 Var: 1 Page Ref: 1.2

LO: 1.1

Global: G2

3) How are gases different from solids and liquids?

- A) Gases can only be made up of atoms.
- B) The particles in a gas attract each other much more strongly than in solids and liquids.
- C) Gases are compressible.
- D) Only gases can take the shape of their container.
- E) Gases are colorless.

Answer: C

Diff: 1 Var: 1 Page Ref: 1.2

LO: 1.1

Global: G2

4) A scientific law

A) is a brief statement that summarizes past observations and makes predictions.

B) is subject to change via legal action.

C) contains an explanation of observations.

D) must have a mathematical formula.

E) cannot be modified.

Answer: A

Diff: 1 Var: 1 Page Ref: 1.3

LO: 1.2

Global: G2

5) All statements about scientific theories are true EXCEPT

A) they explain why nature behaves the way it does.

B) they must have the ability to make predictions on future behavior.

C) they should use observations to test the theory.

D) they are derived from hypothesis.

E) they are speculation.

Answer: E

Diff: 1 Var: 1 Page Ref: 1.3

LO: 1.2

Global: G2

6) A sample of a compound containing only carbon and oxygen decomposes and produces 24.50g of carbon and 32.59g of oxygen. What is the sample?

A) CO

B) CO₂

C) CO₃

D) C₃O₂

E) C₂O

Answer: A

Diff: 3 Var: 1 Page Ref: 1.5

LO: 1.4

Global: G4

7) Rutherford's Gold Foil Experiment helped prove

A) the diameter of a gold atom.

B) the exact charge of an electrons.

C) the exact mass of a gold atom.

D) that the mass of an atom is concentrated in a very small space.

E) the mass to charge ratio of an electron.

Answer: D

Diff: 2 Var: 1 Page Ref: 1.7

LO: 1.5

Global: G2

8) Rank in the order of increasing mass.

- A) proton, neutron, electron
- B) neutron, proton, electron
- C) electron, proton, neutron
- D) electron, neutron, proton
- E) proton, electron, neutron

Answer: C

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

9) The atomic number (Z) is the number of _____ found in the nucleus of an atom.

- A) neutrons
- B) protons
- C) protons and neutrons
- D) electrons
- E) protons and electrons

Answer: B

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

10) A new compound was recently discovered and found to have an atomic weight of 342.38 amu. This element has two isotopes, the lighter of which has a mass of 340.91 amu and an abundance of 68.322%. What is the mass of the heavier isotope?

- A) 350.21
- B) 345.55
- C) 342.38
- D) 348.67
- E) 343.29

Answer: B

Diff: 5 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

11) an atom that has lost an electron is

- A) a cation.
- B) unlikely to be found in homogeneous mixtures.
- C) electrically neutral.
- D) likely to behave exactly like the parent atom.
- E) an anion.

Answer: A

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.6

Global: G2

12) Molecules can be described as

- A) mixtures of two or more pure substances.
- B) mixtures of two or more elements that has a specific ratio between components.
- C) two or more atoms chemically joined together.
- D) heterogeneous mixtures.
- E) homogeneous mixtures.

Answer: C

Diff: 1 Var: 1 Page Ref: 1.2

Global: G1

13) Give the composition of water.

- A) two hydrogen atoms and two oxygen atoms
- B) one hydrogen atom and one oxygen atom
- C) two hydrogen atoms and one oxygen atom
- D) one hydrogen atom and two oxygen atoms

Answer: C

Diff: 1 Var: 1 Page Ref: 1.2

Global: G2

14) Give the composition of hydrogen peroxide.

- A) two hydrogen atoms and two oxygen atoms
- B) one hydrogen atom and one oxygen atom
- C) two hydrogen atoms and one oxygen atom
- D) one hydrogen atom and two oxygen atoms

Answer: A

Diff: 1 Var: 1 Page Ref: 1.2

Global: G2

15) Identify the characteristics of a liquid.

- A) definite volume and definite shape
- B) definite volume and no definite shape
- C) no definite shape and definite volume
- D) no definite shape and no definite volume

Answer: B

Diff: 1 Var: 1 Page Ref: 1.2

LO: 1.1

Global: G2

16) Identify the characteristics of a solid.

- A) definite volume and definite shape
- B) definite volume and no definite shape
- C) no definite shape and definite volume
- D) no definite shape and no definite volume

Answer: A

Diff: 1 Var: 1 Page Ref: 1.2

LO: 1.1

Global: G2

- 17) Identify the characteristics of a gas.
A) definite volume and definite shape
B) definite volume and no definite shape
C) no definite shape and definite volume
D) no definite shape and no definite volume

Answer: D

Diff: 1 Var: 1 Page Ref: 1.2

LO: 1.1

Global: G2

- 18) Which of the following statements about the phases of matter is TRUE?
A) In both solids and liquids, the atoms or molecules pack closely to one another.
B) Solids are highly compressible.
C) Gaseous substances have long-range repeating order.
D) There is only one type of geometric arrangement that the atoms or molecules in any solid can adopt.
E) Liquids have a large portion of empty volume between molecules.

Answer: A

Diff: 1 Var: 1 Page Ref: 1.2

Global: G2

- 19) A substance that can't be chemically broken down into simpler substances is
A) a homogeneous mixture.
B) an element.
C) a heterogeneous mixture.
D) a compound.
E) a gas.

Answer: B

Diff: 1 Var: 1 Page Ref: 1.2

Global: G1

- 20) A substance composed of two or more elements in a fixed, definite proportion is
A) a homogeneous mixture.
B) a heterogeneous mixture.
C) a compound.
D) a solution.
E) an alloy.

Answer: C

Diff: 1 Var: 1 Page Ref: 1.2

Global: G1

21) Two or more substances in variable proportions, where the composition is constant throughout are

- A) a compound.
- B) an element.
- C) a heterogeneous mixture.
- D) a homogeneous mixture.
- E) a crystalline solid.

Answer: D

Diff: 1 Var: 1 Page Ref: 1.2

Global: G1

22) Two or more substances in variable proportions, where the composition is variable throughout are

- A) a solution.
- B) a homogeneous mixture.
- C) a compound.
- D) an amorphous solid.
- E) a heterogeneous mixture.

Answer: E

Diff: 1 Var: 1 Page Ref: 1.2

Global: G1

23) All of the following are SI base units of measurement, EXCEPT

- A) meter.
- B) gram.
- C) second.
- D) kelvin.
- E) mole.

Answer: B

Diff: 1 Var: 1 Page Ref: 1.2

Global: G2

24) Which of the following represents a **hypothesis**?

- A) Sodium reacts with water to form sodium hydroxide and hydrogen gas.
- B) Nitrogen gas is a fairly inert substance.
- C) Nickel has a silvery sheen.
- D) When a substance combusts, it combines with air.
- E) When wood burns, heat is given off.

Answer: D

Diff: 1 Var: 1 Page Ref: 1.3

Global: G2

25) Which of the following represents a valid **hypothesis**?

- A) Neon does not react with oxygen.
- B) Sodium metal reacts violently with water.
- C) Lead is soft and malleable.
- D) Oxygen is a gas at room temperature.
- E) Metals tend to lose electrons.

Answer: E

Diff: 1 Var: 1 Page Ref: 1.3

Global: G2

26) The statement, "In a chemical reaction, matter is neither created nor destroyed" is called

- A) the Law of Conservation of Mass.
- B) Dalton's Atomic Theory.
- C) the Scientific Method.
- D) the Law of Multiple Proportions.
- E) the Law of Definite Proportions.

Answer: A

Diff: 1 Var: 1 Page Ref: 1.3

Global: G2

27) 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 Var: 1 Page Ref: 1.3

Global: G2

28) The Scientific Method

- A) is just a theory.
- B) is a strict set of rules and procedures that lead to inarguable fact.
- C) isn't used much in modern chemistry.
- D) is based on continued observation and experiment.
- E) is a framework for proving an argument you know to be true.

Answer: D

Diff: 1 Var: 1 Page Ref: 1.3

Global: G2

29) Which of the following statements is TRUE?

- A) A scientific law is fact.
- B) Once a theory is constructed, it is considered fact.
- C) A hypothesis is speculation that is difficult to test.
- D) An observation explains why nature does something.
- E) A scientific law summarizes a series of related observations.

Answer: E

Diff: 1 Var: 1 Page Ref: 1.3

Global: G2

30) 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 Var: 1 Page Ref: 1.3

LO: 1.3

Global: G2

31) When two elements 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 Var: 1 Page Ref: 1.3

LO: 1.4

Global: G2

32) 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 Var: 1 Page Ref: 1.3

LO: 1.4

Global: G2

- 33) Which of the following statements is FALSE according to Dalton's Atomic Theory?
- A) Atoms combine in simple whole number ratios to form compounds.
 - B) All atoms of chlorine have identical properties that distinguish them from other elements.
 - C) One carbon atom will combine with one oxygen atom to form a molecule of carbon monoxide.
 - D) Atoms of sodium do not change into another element during 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: E

Diff: 1 Var: 1 Page Ref: 1.3

LO: 1.2

Global: G2

- 34) 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 Var: 1 Page Ref: 1.7

LO: 1.5

Global: G2

- 35) Identify the charges of the 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 Var: 1 Page Ref: 1.7

LO: 1.5

Global: G2

- 36) 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 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G1

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



- A) mercury
- B) chlorine
- C) scandium
- D) bromine
- E) selenium

Answer: D

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

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



- A) silicon
- B) sulfur
- C) zinc
- D) ruthenium
- E) nickel

Answer: A

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

39) Determine the number of protons, neutrons and electrons in the following.



- A) $p^+ = 18$ $n^\circ = 18$ $e^- = 22$
- B) $p^+ = 18$ $n^\circ = 22$ $e^- = 18$
- C) $p^+ = 22$ $n^\circ = 18$ $e^- = 18$
- D) $p^+ = 18$ $n^\circ = 22$ $e^- = 40$
- E) $p^+ = 40$ $n^\circ = 22$ $e^- = 18$

Answer: B

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

40) Determine the number of protons, neutrons and electrons in the following.



A) $p^+ = 12$ $n^\circ = 25$ $e^- = 12$

B) $p^+ = 12$ $n^\circ = 12$ $e^- = 13$

C) $p^+ = 12$ $n^\circ = 13$ $e^- = 12$

D) $p^+ = 25$ $n^\circ = 12$ $e^- = 13$

E) $p^+ = 12$ $n^\circ = 13$ $e^- = 25$

Answer: C

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

41) Determine the number of protons, neutrons and electrons in the following.



A) $p^+ = 36$ $n^\circ = 29$ $e^- = 36$

B) $p^+ = 29$ $n^\circ = 29$ $e^- = 36$

C) $p^+ = 36$ $n^\circ = 36$ $e^- = 29$

D) $p^+ = 29$ $n^\circ = 36$ $e^- = 29$

E) $p^+ = 29$ $n^\circ = 36$ $e^- = 36$

Answer: D

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

42) What element is defined by the following information?

$$p^+ = 11 \quad n^\circ = 12 \quad e^- = 11$$

A) sodium

B) vanadium

C) magnesium

D) titanium

Answer: A

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

43) What element is defined by the following information?

$$p^+ = 20 \quad n^{\circ} = 20 \quad e^- = 20$$

- A) zirconium
- B) calcium
- C) potassium
- D) neon
- E) argon

Answer: B

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

44) What element is defined by the following information?

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

- A) calcium
- B) rubidium
- C) chlorine
- D) neon
- E) oxygen

Answer: C

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

45) 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 Var: 1 Page Ref: 1.8

Global: G2

46) 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 3 or more naturally occurring isotopes.

Answer: E

Diff: 1 Var: 1 Page Ref: 1.8

Global: G2

47) Give the symbol for silver.

- A) S
- B) Si
- C) Ar
- D) Ag
- E) Sl

Answer: D

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

48) Ions differ from atoms in their number of

- A) electrons.
- B) neutrons.
- C) protons.
- D) neutrons and protons.
- E) electrons and protons.

Answer: A

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G1

49) What species is represented by the following information?

$$p^+ = 12 \quad n^{\circ} = 14 \quad e^- = 10$$

- A) Si^{4+}
- B) Mg
- C) Ne
- D) Si
- E) Mg^{2+}

Answer: E

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

50) What species is represented by the following information?

$$p^+ = 47 \quad n^{\circ} = 62 \quad e^- = 46$$

- A) Ag^+
- B) Nd
- C) Pd
- D) Ag
- E) Pd^+

Answer: A

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

51) What species is represented by the following information?

$$p^+ = 17 \quad n^{\circ} = 18 \quad e^- = 18$$

- A) Cl
- B) Cl⁻
- C) Ar
- D) Ar⁺
- E) Kr

Answer: B

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

52) Identify the largest atom or ion of carbon.

- A) $p^+ = 6 \quad n^{\circ} = 6 \quad e^- = 6$
- B) $p^+ = 6 \quad n^{\circ} = 7 \quad e^- = 6$
- C) $p^+ = 6 \quad n^{\circ} = 6 \quad e^- = 7$
- D) $p^+ = 6 \quad n^{\circ} = 6 \quad e^- = 5$

Answer: C

Diff: 2 Var: 1 Page Ref: 1.8

Global: G2

53) Identify the instrument that is used to determine the mass of a molecule.

- A) mass spectrometer
- B) nuclear magnetic resonance spectrometer
- C) infrared spectrometer
- D) gas chromatograph
- E) ultraviolet spectrophotometer

Answer: A

Diff: 1 Var: 1 Page Ref: 1.9

Global: G2

54) The atomic mass for cadmium is

- A) 48
- B) 112.41
- C) 40.08
- D) 20

Answer: B

Diff: 1 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G2

55) Calculate the atomic mass of element "X," if it has 2 naturally occurring isotopes with the following masses and natural abundances.

X-107 106.90509 amu 51.84%

X-109 108.90476 amu 48.46%

A) 107.90 amu

B) 108.00 amu

C) 107.79 amu

D) 108.32 amu

E) 108.19 amu

Answer: E

Diff: 2 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

56) Calculate the atomic mass of gallium if gallium has 2 naturally occurring isotopes with the following masses and natural abundances.

Ga-69 68.9256 amu 60.11%

Ga-71 70.9247 amu 39.89%

A) 69.72 amu

B) 69.93 amu

C) 70.00 amu

D) 69.80 amu

E) 70.68 amu

Answer: A

Diff: 2 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

57) Silver has an atomic mass of 107.868 amu. The Ag-109 isotope (108.91 amu) is 48.16%. What is the mass, in amu, of the other isotope?

A) 106.91 amu

B) 105.87 amu

C) 108.47 amu

D) 106.12 amu

Answer: A

Diff: 3 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

58) Gallium has an atomic mass of 69.723 amu. The Ga-69 (68.926 amu) is 60.111%. What is the amu of the other isotope?

- A) 70.924 amu
- B) 70.932 amu
- C) 70.928 amu
- D) 70.920 amu

Answer: A

Diff: 3 Var: 1 Page Ref: 2.8

LO: 1.6

Global: G4

59) Silver has an atomic mass of 107.868 amu. The Ag-109 isotope (108.905 amu) is 48.161%. What is the amu of the other isotope?

- A) 106.905 amu
- B) 106.908 amu
- C) 106.903 amu
- D) 106.911 amu

Answer: A

Diff: 3 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

60) Calculate the atomic mass of element "X," if it has 2 naturally occurring isotopes with the following masses and natural abundances.

X-45 44.8776 amu 32.88%

X-47 46.9443 amu 67.12%

- A) 46.26 amu
- B) 45.91 amu
- C) 46.34 amu
- D) 46.84 amu
- E) 44.99 amu

Answer: A

Diff: 3 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

61) 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 Var: 1 Page Ref: 1.10

LO: 1.8

Global: G4

62) 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 Var: 1 Page Ref: 1.10

LO: 1.8

Global: G4

63) 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 Var: 1 Page Ref: 1.10

LO: 1.8

Global: G4

64) 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 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

65) 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 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

66) 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: 4 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

67) 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: 4 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

68) 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 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

69) 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 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

70) How many nitrogen atoms are contained in 485 cmol of atomic nitrogen?

- A) 4.25×10^{22} N atoms
- B) 7.87×10^{25} N atoms
- C) 2.60×10^{23} N atoms
- D) 2.92×10^{24} N atoms
- E) 5.37×10^{26} N atoms

Answer: D

Diff: 2 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

71) Calculate the mass (in mg) of 4.82×10^{22} atoms of sodium.

- A) 3.48 mg
- B) 287×10^3 mg
- C) 287 mg
- D) 1.84×10^3 mg
- E) 1.84 mg

Answer: D

Diff: 4 Var: 1 Page Ref: 1.10

LO: 1.7

Global: G4

72) Calculate the atomic mass of magnesium if magnesium has 3 naturally occurring stable isotopes with the following masses and natural abundances.

| | | |
|-------|-------------|--------|
| Mg-24 | 23.9996 amu | 78.99% |
| Mg-25 | 24.9858 amu | 10.00% |
| Mg-26 | 25.9826 amu | 11.01% |

- A) 22.53 amu
- B) 24.32 amu
- C) 24.86 amu
- D) 25.41 amu
- E) 23.92 amu

Answer: B

Diff: 2 Var: 1 Page Ref: 1.9

LO: 1.6

Global: G4

73) What species is represented by the following information?

$$p^+ = 53 \quad n^{\circ} = 76 \quad e^- = 54$$

- A) Os
- B) Os⁻
- C) I⁺
- D) I
- E) I⁻

Answer: E

Diff: 2 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

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



- A) protactinium
- B) zirconium
- C) manganese
- D) xenon
- E) titanium

Answer: B

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

1.2 Algorithmic Questions

1) Identify the crystalline solid.

- A) plastic
- B) glass
- C) table salt
- D) water
- E) bleach

Answer: C

Diff: 1 Var: 8 Page Ref: 1.2

Global: G2, G5

2) Choose the pure substance from the list below.

- A) coffee
- B) a casserole
- C) carbon dioxide
- D) salt water
- E) pomegranate juice

Answer: C

Diff: 1 Var: 8 Page Ref: 1.2

Global: G2, G5

3) A wooden baseball bat is an example of

- A) a compound.
- B) an element.
- C) a heterogeneous mixture.
- D) a homogeneous mixture.

Answer: C

Diff: 2 Var: 5 Page Ref: 1.2

Global: G2, G5

4) Natural gas is an example of

- A) a compound.
- B) an element.
- C) a heterogeneous mixture.
- D) a homogeneous mixture.

Answer: D

Diff: 2 Var: 5 Page Ref: 1.3

Global: G2

5) Iodine is an example of

- A) a compound.
- B) an element.
- C) a heterogeneous mixture.
- D) a homogeneous mixture.

Answer: B

Diff: 2 Var: 5 Page Ref: 1.2

Global: G2

6) Water is an example of

- A) a compound.
- B) an element.
- C) a heterogeneous mixture.
- D) a homogeneous mixture.

Answer: A

Diff: 2 Var: 4 Page Ref: 1.2

Global: G2

7) Identify a solid.

- A) copper
- B) oxygen
- C) water
- D) nitrogen
- E) air

Answer: A

Diff: 1 Var: 15 Page Ref: 1.2

Global: G2

8) Identify a liquid.

- A) oxygen
- B) tin
- C) salt
- D) water
- E) sugar

Answer: D

Diff: 1 Var: 25 Page Ref: 1.2

Global: G2

9) Choose the pure substance from the list below.

- A) sea water
- B) diamond
- C) air
- D) coffee
- E) milk

Answer: B

Diff: 1 Var: 12 Page Ref: 1.2

Global: G2, G5

10) Choose the element from the list below.

- A) sodium chloride
- B) water
- C) carbon monoxide
- D) argon
- E) rust

Answer: D

Diff: 1 Var: 9 Page Ref: 1.2

Global: G2

11) Choose the compound from the list below.

- A) sodium
- B) methanol
- C) neon
- D) helium
- E) lithium

Answer: B

Diff: 1 Var: 20 Page Ref: 1.2

Global: G2

12) Choose the heterogeneous mixture from the list below.

- A) sports drink
- B) chlorine gas
- C) black coffee
- D) lasagna
- E) carbon (graphite)

Answer: D

Diff: 1 Var: 12 Page Ref: 1.2

Global: G2, G5

13) Choose the homogeneous mixture from the list below.

- A) wine
- B) mud
- C) ice water
- D) salad
- E) salsa

Answer: A

Diff: 1 Var: 12 Page Ref: 1.2

Global: G2, G5

14) Choose the homogeneous mixture from the list below.

- A) cola float
- B) air
- C) concrete
- D) cereal
- E) blood

Answer: B

Diff: 2 Var: 8 Page Ref: 1.2

Global: G2, G5

15) Identify the element that has an atomic number of 20.

- A) boron
- B) neon
- C) calcium
- D) zinc

Answer: C

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

16) Give the symbol for magnesium.

- A) Mg
- B) Mn
- C) Ma
- D) Mag
- E) Me

Answer: A

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

17) An atom of ^{17}O contains _____ protons.

- A) 8
- B) 25
- C) 9
- D) 11
- E) 17

Answer: A

Diff: 1 Var: 17 Page Ref: 1.8

LO: 1.5

Global: G4

18) An atom of ^{32}P contains _____ electrons.

- A) 32
- B) 47
- C) 17
- D) 27
- E) 15

Answer: E

Diff: 1 Var: 17 Page Ref: 1.8

LO: 1.5

Global: G4

19) The atomic number of an atom of ^{13}C is

- A) 19
- B) 6
- C) 7
- D) 9
- E) 13

Answer: B

Diff: 1 Var: 17 Page Ref: 1.8

LO: 1.5

Global: G2

20) How many electrons are in titanium?

- A) 22
- B) 25
- C) 26
- D) 25.9
- E) 47.9

Answer: A

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

21) How many neutrons are in magnesium?

- A) 12
- B) 13
- C) 14
- D) 12.3
- E) 24.3

Answer: C

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

22) How many protons are in nickel?

- A) 28
- B) 30
- C) 31
- D) 30.7
- E) 58.7

Answer: A

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

23) An ion has 12 protons, 14 neutrons, and 10 electrons. The symbol for the ion is

- A) $^{26}\text{Mg}^{2+}$
- B) $^{26}\text{Mg}^{2-}$
- C) $^{24}\text{Si}^{2+}$
- D) $^{24}\text{Si}^{2-}$
- E) $^{26}\text{Ne}^{2-}$

Answer: A

Diff: 1 Var: 10 Page Ref: 1.8

LO: 1.5

Global: G2

24) Isotopes differ in the number of

- A) gamma particles.
- B) protons.
- C) electrons.
- D) neutrons.
- E) protons and electrons.

Answer: D

Diff: 1 Var: 6 Page Ref: 1.8

LO: 1.5

Global: G1

25) An atom that has an atomic number of 38 and a mass number of 88 is an isotope of an atom that has

- A) an atomic number of 39 and a mass number of 88.
- B) an atomic number of 38 and a mass number of 86.
- C) 50 neutrons and 38 protons.
- D) 50 protons and 38 neutrons.

Answer: B

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

26) Which of the following represent isotopes?

A: ${}_{21}^{46}\text{X}$ B: ${}_{22}^{46}\text{X}$ C: ${}_{21}^{44}\text{X}$ D: ${}_{23}^{48}\text{X}$

- A) A and B
- B) A and C
- C) A and D
- D) C and D

Answer: B

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

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

${}_{17}^{35}\text{X}$

- A) selenium
- B) krypton
- C) sulfur
- D) bromine
- E) chlorine

Answer: E

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

28) How many protons (p) and neutrons (n) are in an atom of ${}^{98}_{43}\text{Tc}$?

- A) 43 p, 55 n
- B) 43 p, 98 n
- C) 55 p, 43 n
- D) 98 p, 43 n

Answer: A

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

29) How many protons (p) and neutrons (n) are in an atom of strontium-90?

- A) 38 p, 52 n
- B) 38 p, 90 n
- C) 52 p, 38 n
- D) 90 p, 38 n

Answer: A

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

30) What is the element symbol for an atom that has 29 protons and 36 neutrons?

- A) Cu
- B) Kr
- C) N
- D) Tb

Answer: A

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

31) How many electrons are in a neutral atom of astatine-211?

- A) 1
- B) 85
- C) 86
- D) 211

Answer: B

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

32) Identify the chemical symbol of element Q in $^{18}_8\text{Q}$.

- A) Ar
- B) F
- C) Ne
- D) O

Answer: D

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G2

33) An atom of ^{26}Mg contains _____ neutrons.

- A) 12
- B) 38
- C) 14
- D) 24
- E) 26

Answer: C

Diff: 2 Var: 17 Page Ref: 1.8

LO: 1.5

Global: G4

34) The mass number of an atom of ^{25}Mg is

- A) 12
- B) 37
- C) 13
- D) 25
- E) 23

Answer: D

Diff: 2 Var: 17 Page Ref: 1.8

LO: 1.5

Global: G2

35) The atomic mass for silver is

- A) 28.09
- B) 14
- C) 107.87
- D) 47

Answer: C

Diff: 1 Var: 4 Page Ref: 1.8

LO: 1.5

Global: G2

36) The atomic number for iron is

- A) 192.22
- B) 77
- C) 55.85
- D) 26

Answer: D

Diff: 1 Var: 4 Page Ref: 1.8

LO: 1.5

Global: G2

37) Which of the following contains the **most** atoms? You shouldn't need to do a calculation here.

- A) 10.0 g Al
- B) 10.0 g He
- C) 10.0 g Ca
- D) 10.0 g Kr
- E) 10.0 g Cs

Answer: B

Diff: 1 Var: 50+ Page Ref: 1.10

LO: 1.7

Global: G2

38) Which of the following contains the **fewest** atoms? You shouldn't need to do a calculation here.

- A) 10.0 g Mg
- B) 10.0 g Li
- C) 10.0 g Ca
- D) 10.0 g Rb
- E) 10.0 g Cs

Answer: E

Diff: 1 Var: 50+ Page Ref: 1.10

LO: 1.7

Global: G2

39) How many Zn atoms are contained in 922 g of Zn?

- A) 5.90×10^{25} Zn atoms
- B) 7.09×10^{21} Zn atoms
- C) 8.49×10^{24} Zn atoms
- D) 4.27×10^{22} Zn atoms
- E) 4.18×10^{24} Zn atoms

Answer: C

Diff: 3 Var: 5 Page Ref: 1.10

LO: 1.7

Global: G4

40) Calculate the mass (in g) of 2.0×10^{24} atoms of Hg.

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 Var: 5 Page Ref: 1.10

LO: 1.7

Global: G4

41) How many magnesium atoms are contained in 3.75 moles of magnesium?

A) 1.23×10^{24} magnesium atoms

B) 2.26×10^{24} magnesium atoms

C) 1.61×10^{23} magnesium atoms

D) 5.48×10^{25} magnesium atoms

E) 6.50×10^{25} magnesium atoms

Answer: B

Diff: 2 Var: 4 Page Ref: 1.10

LO: 1.7

Global: G4

42) What mass (in g) does 7.98 moles of Kr have?

A) 668 g

B) 952 g

C) 422 g

D) 480 g

E) 288 g

Answer: A

Diff: 2 Var: 5 Page Ref: 1.10

LO: 1.8

Global: G4

43) How many moles of potassium are contained in 150 g of potassium?

A) 3.83 moles

B) 0.720 moles

C) 10.0 moles

D) 7.90 moles

E) 4.85 moles

Answer: A

Diff: 2 Var: 5 Page Ref: 1.10

LO: 1.8

Global: G4

44) 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 Var: 6 Page Ref: 1.10

LO: 1.7

Global: G4

45) How many atoms are in 2.50 moles of SiO_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 Var: 5 Page Ref: 1.10

LO: 1.7

Global: G4

46) How many molecules are in 2.50 moles of SiO_2 ?

- A) 4.52×10^{24} atoms
- B) 1.51×10^{24} atoms
- C) 5.02×10^{23} atoms
- D) 3.01×10^{24} atoms
- E) 7.53×10^{23} atoms

Answer: B

Diff: 3 Var: 5 Page Ref: 1.10

LO: 1.7

Global: G4

47) How many atoms of carbon are in 2.50 moles of CO_2 ?

- A) 4.52×10^{24} atoms
- B) 1.51×10^{24} atoms
- C) 5.02×10^{23} atoms
- D) 3.01×10^{24} atoms
- E) 7.53×10^{23} atoms

Answer: B

Diff: 3 Var: 5 Page Ref: 1.10

LO: 1.7

Global: G4

48) How many atoms of oxygen are in 2.50 moles of SO_2 ?

A) 4.52×10^{24} atoms

B) 1.51×10^{24} atoms

C) 5.02×10^{23} atoms

D) 3.01×10^{24} atoms

E) 7.53×10^{23} atoms

Answer: D

Diff: 3 Var: 3 Page Ref: 1.10

LO: 1.7

Global: G4

49) What mass (in kg) does 4.77 moles of nickel 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 Var: 5 Page Ref: 1.10

LO: 1.8

Global: G4

50) What mass (in mg) does 0.04518 moles of silver have?

A) 8402 mg

B) 154.2 mg

C) 2284 mg

D) 4874 mg

E) 843.0 mg

Answer: D

Diff: 3 Var: 5 Page Ref: 1.10

LO: 1.8

Global: G4

51) How many S atoms are contained in 4.004 kg of S?

A) 7.53×10^{25} S atoms

B) 4.36×10^{24} S atoms

C) 1.74×10^{22} S atoms

D) 9.35×10^{26} S atoms

E) 6.93×10^{24} S atoms

Answer: A

Diff: 3 Var: 5 Page Ref: 1.10

LO: 1.9

Global: G4

52) How many electrons are in a neutral atom of phosphorus-31?

- A) 14
- B) 15
- C) 16
- D) 17
- E) 31

Answer: B

Diff: 2 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

53) The atomic number for lithium is

- A) 12.01
- B) 57
- C) 3
- D) 6.94

Answer: C

Diff: 1 Var: 4 Page Ref: 1.8

LO: 1.5

Global: G2

54) How many protons are in krypton?

- A) 35
- B) 36
- C) 37
- D) 83.8
- E) 88.3

Answer: B

Diff: 1 Var: 5 Page Ref: 1.8

LO: 1.5

Global: G4

1.3 Short Answer Questions

1) Define an atom.

Answer: An atom is the submicroscopic particle that constitutes the fundamental building block of ordinary matter.

Diff: 1 Var: 1 Page Ref: 1.1

Global: G1, G8

2) Define matter.

Answer: Matter is anything that occupies space and has mass.

Diff: 1 Var: 1 Page Ref: 1.1

Global: G1, G8

3) A sample of liquid isopropyl alcohol is placed in a sealed container. Some of the volatile isopropyl alcohol vaporizes. Does the mass of the sealed container and its contents change during the vaporization? Explain.

Answer: No. The vaporized isopropyl alcohol is just in a different physical state. It still has mass and therefore the gas plus the remaining liquid and container have the same total mass after the vaporization of some of the isopropyl alcohol.

Diff: 1 Var: 1 Page Ref: 1.2

Global: G8

4) Describe an atom and what it is made of according to modern atomic theory.

Answer: An atom is made 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 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 Var: 1 Page Ref: 1.5

Global: G1, G8

5) The atomic number is equal to the number of _____.

Answer: protons

Diff: 1 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2

6) 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 Var: 1 Page Ref: 1.8

LO: 1.5

Global: G2, G8

7) Why doesn't the mass spectrum of silver have a peak at 107.9 amu?

Answer: The average atomic mass of silver is 107.9 amu, but there are no atoms of silver that weigh 107.9 amu. One isotope weighs more and another weighs less.

Diff: 1 Var: 1 Page Ref: 1.8

Global: G2, G8

8) 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 Var: 1 Page Ref: 1.9

Global: G2

9) The number 6.022×10^{23} is called _____.

Answer: Avogadro's number

Diff: 1 Var: 1 Page Ref: 1.10

Global: G2