Chapter 0
A Very Brief History of Chemistry

Multiple Choice Questions

1. Which of the following is the logical progression of elements formed in a star?

    a. Hydrogen → Helium → Argon → Carbon
    b. Hydrogen → Helium → Carbon → Argon
    c. Helium → Hydrogen → Argon → Carbon
    d. Helium → Hydrogen → Carbon → Argon
    e. Argon → Carbon → Helium → Hydrogen

Answer: b
Section 0.2
Difficulty Level: medium

2. Why is iron the heaviest element formed in a star prior to a super nova?

    a. The formation of iron in a star starts a cooling process of the star, ending nucleosynthesis.
    b. Iron reacts with the hydrogen in stars to cause a violet explosion which leads to a super nova.
    c. Iron is the heaviest element that is stable at high temperatures, all others are radioactive.
    d. The formation of iron in a star causes a reaction with helium that causes nucleosynthesis to end.
    e. When iron is formed in the outer layers of a star is has enough kinetic energy to leave the gravity of the star and therefore is able to remove itself from the star.

Answer: a
Section 0.2
Difficulty Level: medium

3. One would expect a fairly even distribution of elements on earth; instead we see an uneven distribution of elements through the earth. Which of the following best describes why we observe this?

    a. The nebula that formed the earth had elements that were not evenly distributed.
    b. Winds on the surface of the earth have moved around the heavy and light elements into bands.
    c. The early earth liquefied, resulting in heavier elements migrating towards the core, and lighter elements towards the surface. This migration to the surface was largely by lava flows, which were inconsistent.
    d. Some elements were soluble in water washed them into pockets on the surface.
    e. The magnetic properties of the core caused the metals to pool into certain areas between the poles on earth.

Answer: c
Section 0.2
Difficulty Level: medium

4. The relative number of atoms of each element in a particular compound

    a. is always l:l.
    b. is the same as the density ratio.
    c. is the same as the weight ratio.
    d. is definite and constant.
    e. cannot be determined experimentally.

Answer: d
Section 0.4
Difficulty Level: easy

5. Which of the following postulates from Dalton's atomic theory are now considered incorrect?

I. All the atoms of a given element are identical.
II. Matter consists of very small particles known as atoms.
III. Atoms are indestructible and also indivisible.

a. III only.
b. II only.
c. I only.
d. I and II
e. I and III

Answer: e
Section 0.4
Difficulty Level: medium

6. Which of the following statements is/are consistent with Dalton's atomic theory?

I. The atoms in a given sample of an element do not share any common properties.
II. Matter consists of particles called atoms.
III. In chemical reactions, atoms merely rearrange, but do not disintegrate.

a. III only.
b. II only.
c. I only.
d. II and III
e. I and III

Answer: d
Section 0.4
Difficulty Level: medium

7. Which of the following statements is/are NOT consistent with Dalton's atomic theory?

I. The atoms in a given sample of an element do not share any common properties.
II. Matter consists of tiny particles called molecular substances.
III. In chemical reactions, atoms merely rearrange, but do not disintegrate.

a. III only.
b. II only.
c. I only.
d. II and III
e. I and II

Answer: e
Section 0.4
Difficulty Level: medium

8. Which of the following postulates from Dalton's atomic theory is incorrectly stated?

a. The atoms in a given sample of an element are identical.
b. Matter consists of tiny particles called atoms.
c. In chemical reactions, atoms merely rearrange, but do not disintegrate.
d. In a given chemical compound, the atoms can be present in various numerical ratios.
e. In a given chemical compound, the atoms are always present in the same fixed numerical ratio.

Answer: d
Section 0.4
Difficulty Level: medium

9. Which of the following is consistent with the postulates from Dalton's atomic theory?

a. The atoms in a given sample of an element are not necessarily identical.
b. Matter consists of tiny particles called ions.
c. In chemical reactions, atoms not only rearrange, but also disintegrate in smaller subatomic particles.
d. In a given chemical compound, the atoms can be present in various numerical ratios.
e. In a given chemical compound, the atoms are always present in the same fixed numerical ratio.

Answer: e
Section 0.4
Difficulty Level: medium

10. Which one of the statements below is true?

a. When two atoms combine to form a chemical compound, they do so in many different proportions by mass.
b. When two different compounds combine to form an element, they do so in definite proportions by mass.
c. When two different elements combine to form a chemical compound, they do so in definite proportions by mass.
d. When two molecules combine in a chemical reaction, a number of different elements can be generated depending on the masses used.
e. When two different elements combine to form a mixture, they do so in definite proportions by weight.

Answer: c
Section 0.4
Difficulty Level: medium

11. Which one of the statements below is false?

a. In chemical reactions, atoms are rearranged.
b. In a given compound, the atoms are always present in the same fixed numerical ratio.
c. Matter is made up of tiny particles called atoms.
d. In a sealed reaction flask, the total mass after the reaction is over, is the same as before the reaction started.
e. When hydrogen and oxygen react to form water, the mass of oxygen is equal to the mass of hydrogen.

Answer: e
Section 0.4
Difficulty Level: medium

12. Which of the following examples is consistent with the postulates from Dalton's atomic theory?

a. The atoms in a sample of chlorine are similar to the atoms in a sample of elemental sulfur.
b. Matter consists of extremely tiny particles which are either positively or negatively charged.
c. When water is formed from oxygen and hydrogen molecules, the atoms in water are grouped differently compared to those in hydrogen and oxygen.
d. When a sample of water is analyzed, it is discovered that the hydrogen and the oxygen atoms are combined in only two different ratios by mass.
e. There are eight different types of sulfur atoms in any naturally occurring sample of elemental sulfur.

Answer: c
Section 0.4
Difficulty Level: hard

13. In the formation of hydrogen sulfide, H_2S, from hydrogen and sulfur 4.03 g of hydrogen are reacted with 62.13 g of sulfur. If all of the hydrogen and sulfur completely react to form hydrogen sulfide how many grams of hydrogen sulfide should be formed?

a. 66.16 g
b. 58.10 g
c. 4.03 g
d. 70.19 g
e. 33.03 g

Answer: a
Section 0.4
Difficulty Level: medium

14. Which of these scientists developed the **atomic theory**?

a. John Dalton
b. J. J. Thomson
c. Robert Millikan
d. Henry Moseley
e. Ernest Rutherford

Answer: a
Section 0.4
Difficulty Level: medium

15. When J. J. Thomson discovered the electron, what physical property of the electron did he measure?

a. Its charge.
b. Its charge-to-mass ratio.
c. Its temperature.
d. Its mass.
e. Its atomic number.

Answer: b
Section 0.4
Difficulty Level: medium

16. Which one of the following contributes to the charge, but does NOT contribute significantly to the mass of an atom?

a. electrons
b. nuclei
c. photons
d. neutrons
e. protons

Answer: a
Section 0.5
Difficulty Level: easy

17. Which of the following have roughly the same mass?

a. A proton and an electron.
b. A neutron and an electron.
c. A neutron and a proton.
d. An electron and an alpha particle.
e. None of these options.

Answer: c
Section 0.5
Difficulty Level: easy

18. Which of the following have equal, but opposite, electronic charges?

a. A proton and an electron.
b. A neutron and an electron.
c. A neutron and a proton.
d. An electron and an alpha particle.
e. None of these options.

Answer: a
Section 0.5
Difficulty Level: easy

19. Consider the atoms of ^{65}Cu and ^{65}Zn. Both of these atoms have the same

a. number of electrons.
b. number of ions.
c. number of neutrons.
d. mass number.
e. number of protons.

Answer: d
Section 0.5
Difficulty Level: easy

20. Which of the following particles will not be deflected by charged plates?

a. hydrogen atoms
b. cathode rays
c. alpha particles
d. protons
e. These are all deflected by charged plates.

Answer: a
Section 0.5
Difficulty Level: medium

21. Uranium exists in nature in the form of several isotopes; the different isotopes have different

a. atomic numbers.
b. charges.
c. numbers of electrons.
d. numbers of neutrons.
e. numbers of protons.

Answer: d
Section 0.5
Difficulty Level: medium

22. Two isotopes of an element differ only in their

a. symbol.
b. atomic number.
c. atomic mass.
d. number of protons.
e. number of electrons.

Answer: c
Section 0.5
Difficulty Level: easy

23. Which answer below best describes all atoms of a given isotope of a particular element?

a. They possess the same mass, only.
b. They possess the same chemical properties and the same mass, but nothing else in common.
c. They possess the same atomic number and the same mass, but have nothing else in common.
d. They possess the same number of electrons, the same atomic number, the same mass, but nothing else in common.
e. They possess the same number of electrons, the same atomic number, the same mass, and the same chemical properties.

Answer: e
Section 0.5
Difficulty Level: medium

24. Which answer below best describes all atoms of a particular element?

a. They possess the same number of electrons, the same atomic number, the same mass, but nothing else in common.
b. They possess the same mass and the same chemical properties, but nothing else in common.
c. They possess the same number of electrons, the same atomic number, the same chemical properties, but not necessarily the same mass.
d. They possess the same chemical properties and the same mass, but nothing else in common.
e. They possess the same atomic number and the same mass, but have nothing else in common.

Answer: c
Section 0.5
Difficulty Level: medium

25. The species shown below which has 24 neutrons is

a. $^{52}_{24}Cr$
b. $^{55}_{25}Mn$
c. $^{24}_{12}Mg$
d. $^{45}_{21}Sc$
e. $^{51}_{23}V$

Answer: d
Section 0.5
Difficulty Level: medium

26. The species shown below which has 24 electrons is

a. $^{52}_{24}Cr$
b. $^{55}_{25}Mn$
c. $^{24}_{12}Mg$
d. $^{45}_{21}Sc$
e. $^{51}_{23}V$

Answer: a
Section 0.5
Difficulty Level: medium

27. The species, $^{51}_{23}V$, has the same number of neutrons as

a. $^{50}_{23}V$
b. $^{45}_{21}Sc$
c. $^{55}_{25}Mn$
d. $^{52}_{24}Cr$
e. $^{59}_{27}Co$

Answer: d
Section 0.5
Difficulty Level: medium

28. Consider the atoms of $^{26}_{12}Mg$ and $^{27}_{13}Al$. Both of these species have the same

a. number of neutrons and electrons.
b. number of ions.
c. number of neutrons.
d. number of neutrons and mass number.
e. number of protons and electrons.

Answer: c
Section 0.5
Difficulty Level: medium

29. Consider the atoms of ^{59}Co and ^{60}Co. Both of these atoms have the same

a. number of neutrons and electrons.
b. number of neutrons and ions.
c. mass number.
d. number of photons.
e. number of protons and electrons.

Answer: e
Section 0.5
Difficulty Level: medium

30. An atom of the isotope sulfur-33($^{33}_{16}S$) consists of how many protons, neutrons, and electrons? The atomic number of sulfur is 16. (p = proton, n = neutron, e = electron)

a. 15 p, 18 n, 15 e
b. 16 p, 17 n, 16 e
c. 33 p, 16 n, 33 e
d. 16 p, 16 n, 33 e
e. 16 p, 33 n, 16 e

Answer: b
Section 0.5
Difficulty Level: easy

31. An atom of the isotope chlorine-35 ($^{35}_{17}Cl$) consists of how many protons, neutrons, and electrons? The atomic number of chlorine is 17. (p = proton, n = neutron, e = electron)

a. 17 p, 35 n, 17 e
b. 17 p, 17 n, 35 e
c. 18 p, 17 n, 18 e
d. 17 p, 18 n, 17 e
e. 35 p, 17 n, 18 e

Answer: d
Section 0.5
Difficulty Level: easy

32. Compare $^{26}_{12}Mg$ and $^{27}_{13}Al$. In what respect do these species differ?

I. number of neutrons, and number of electrons.
II. number of protons, and number of neutrons.
III. mass number and number of protons.

a. I only
b. II only
c. III only
d. I and III
e. I, II, and III

Answer: c
Section 0.5
Difficulty Level: medium

33. A neutral iodine atom has an atomic mass number = 131. Which description below fits this atom?

a. 39 protons, 78 neutrons, 39 electrons
b. 53 protons, 78 neutrons, 53 electrons
c. 52 protons, 79 neutrons, 54 electrons
d. 53 protons, 131 neutrons, 53 electrons
e. 54 protons, 131 neutrons, 54 electrons

Answer: b
Section 0.5
Difficulty Level: medium

34. Which description below fits the ^{65}Cu atom?

a. 29 protons, 65 neutrons, 29 electrons
b. 29 protons, 36 neutrons, 65 electrons
c. 29 protons, 36 neutrons, 31 electrons
d. 29 protons, 36 neutrons, 29 electrons
e. 31 protons, 34 neutrons, 29 electrons

Answer: d
Section 0.5
Difficulty Level: medium

35. Which description below fits the ^{112}Cd atom?

a. 48 protons, 64 neutrons, 48 electrons
b. 48 protons, 62 neutrons, 48 electrons
c. 48 protons, 64 neutrons, 46 electrons
d. 48 protons, 62 neutrons, 46 electrons
e. 50 protons, 64 neutrons, 48 electrons

Answer: a
Section 0.5
Difficulty Level: medium

36. The atomic mass of naturally occurring iron, which is a mixture of isotopes, is listed as 55.847 **u**. This means that the average mass of iron is

a. 55.847 times as great as that of a ^{12}C atom
b. 55.847 times as great as that of a ^{1}H atom
c. 55.847/1.0079 times as great as that of a ^{1}H atom
d. 55.847/12.000 times as great as that of a ^{12}C atom
e. 55.847/12.011 times as great as that of a ^{12}C atom

Answer: d
Section 0.5
Difficulty Level: medium

37. The atomic mass of naturally occurring nickel, which is a mixture of isotopes, is listed as 58.6934 **u**. This means that the average mass of nickel is

a. 58.6934 times as great as that of a ^{12}C atom
b. 58.6934 times as great as that of a ^{1}H atom
c. 58.6934/1.0079 times as great as that of a ^{1}H atom
d. 58.6934/12.000 times as great as that of a ^{12}C atom
e. 58.6934/12.011 times as great as that of a ^{12}C atom

Answer: d
Section 0.5
Difficulty Level: medium

38. The atomic mass of naturally occurring silver, which is a mixture of two isotopes, is listed as 107.868 **u**. This means that

a. all silver atoms found in nature have a mass which is 107.868/12.000 times as great as that of a ^{12}C atom.
b. all silver atoms found in nature have a mass which is 107.868/1.0079 times as great as that of a ^{1}H atom.
c. some silver atoms found in nature have a mass which is 107.868/12.000 times as great as that of a ^{12}C atom.
d. some silver atoms found in nature have a mass which is 107.868/1.0079 times as great as that of a ^{1}H atom.
e. no silver atoms found in nature has a mass which is 107.868/12.000 times as great as that of a ^{12}C atom.

Answer: e
Section 0.5
Difficulty Level: medium

39. The atomic mass of naturally occurring copper, which is a mixture of two isotopes, is listed as 63.546 **u**. This means that

a. all copper atoms found in nature have a mass which is 63.546/12.000 times as great as that of a ^{12}C atom.
b. all copper atoms found in nature have a mass which is 63.546/1.0079 times as great as that of a ^{1}H atom.
c. some copper atoms found in nature have a mass which is 63.546/12.000 times as great as that of a ^{12}C atom.
d. some copper atoms found in nature have a mass which is 63.546/1.0079 times as great as that of a ^{1}H atom.
e. no copper atoms found in nature has a mass which is 63.546/12.000 times as great as that of a ^{12}C atom.

Answer: e
Section 0.5
Difficulty Level: medium

40. The atomic mass of naturally occurring gallium, which is a mixture of two isotopes, is listed as 69.723 **u**. This means that

a. all gallium atoms found in nature have a mass which is 69.723/12.000 times as great as that of a ^{12}C atom.
b. all gallium atoms found in nature have a mass which is 69.723/1.0079 times as great as that of a ^{1}H atom.
c. some gallium atoms found in nature have a mass which is 69.723/12.000 times as great as that of a ^{12}C atom.
d. some gallium atoms found in nature have a mass which is 69.723/1.0079 times as great as that of a ^{1}H atom.
e. no gallium atoms found in nature has a mass which is 69.723/12.000 times as great as that of a ^{12}C atom.

Answer: e
Section 0.5
Difficulty Level: medium

41. The atomic mass of naturally occurring fluorine, which exists in nature as a single isotope, is listed as 18.9984 **u**. This means that

a. all fluorine atoms found in nature have a mass which is 18.9984/12.000 times as great as that of a ^{12}C atom.
b. all fluorine atoms found in nature have a mass which is 18.9984/1.0079 times as great as that of a ^{1}H atom.
c. some fluorine atoms found in nature have a mass which is 18.9984/12.000 times as great as that of a ^{12}C atom.
d. some fluorine atoms found in nature have a mass which is 18.9984/1.0079 times as great as that of a ^{1}H atom.
e. no fluorine atom found in nature has a mass which is 18.9984/12.000 times as great as that of a ^{12}C atom.

Answer: a
Section 0.5
Difficulty Level: medium

42. The atomic mass of naturally occurring cobalt, which exists in nature as a single isotope, is listed as 58.9332 **u**. This means that

a. all cobalt atoms found in nature have a mass which is 58.9332/12.000 times as great as that of a ^{12}C atom.
b. all cobalt atoms found in nature have a mass which is 58.9332/1.0079 times as great as that of a ^{1}H atom.
c. some cobalt atoms found in nature have a mass which is 58.9332/12.000 times as great as that of a ^{12}C atom.
d. some cobalt atoms found in nature have a mass which is 58.9332/1.0079 times as great as that of a ^{1}H atom.
e. no cobalt atom found in nature has a mass which is 58.9332/12.000 times as great as that of a ^{12}C atom.

Answer: a
Section 0.5
Difficulty Level: medium

43. A naturally occurring element consists of **three** isotopes. The data for the isotopes are:

isotope 1: 46.972 **u**, 69.472%
isotope 2: 48.961 **u**, 21.667%
isotope 3: 49.954 **u**, 8.8610%

What is the average atomic mass of this naturally occurring element?

a. 47.667 **u**
b. 47.699 **u**
c. 48.629 **u**
d. 48.667 **u**
e. 48.961 **u**

Answer: a
Section 0.5
Difficulty Level: hard

44. A naturally occurring element consists of **three** isotopes. The data for the isotopes are:

isotope 1: 146.9672 **u**, 64.792%
isotope 2: 148.9638 **u**, 26.117%
isotope 3: 149.9592 **u**, 9.0910%

What is the average atomic mass of this naturally occurring element?

a. 49.254 **u**
b. 147.76 **u**
c. 148.63 **u**
d. 148.67 **u**
e. 147.88 **u**

Answer: b
Section 0.5
Difficulty Level: hard

45. A naturally occurring element consists of **three** isotopes. The data for the isotopes are:

isotope 1: 187.9122 **u**., 10.861%
isotope 2: 190.9047 **u**, 12.428%
isotope 3: 192.8938 **u**, 76.711%

What is the average atomic mass of this naturally occurring element?

a. 64.035 **u**
b. 190.57 **u**
c. 190.67 **u**
d. 192.08 **u**
e. 192.11 **u**

Answer: e
Section 0.5
Difficulty Level: hard

46. A naturally occurring element consists of **three** isotopes. The data for the isotopes are:

isotope 1: 147.9554 **u**, 10.563%
isotope 2: 150.9496 **u**, 70.811%
isotope 3: 152.9461 **u**, 18.626%

What is the average atomic mass of this naturally occurring element?

a. 50.335 **u**
b. 150.62 **u**
c. 150.67 **u**
d. 151.01 **u**
e. 151.08 **u**

Answer: d
Section 0.5
Difficulty Level: hard

47. A naturally occurring element consists of **<u>two</u>** isotopes. The data for the isotopes are:

isotope 1 68.5257 **u** 60.226 %
isotope 2 70.9429 **u** ?????? %

Calculate the average atomic mass of this element.

a. 69.728 **u**
b. 69.743 **u**
c. 69.934 **u**
d. 69.972 **u**
e. 70.141 **u**

Answer: a
Section 0.5
Difficulty Level: hard

Fill-in-the-Blank Questions

48. Chemistry has four main ideas that were given in chapter 0. List them.
Answer: 1. Dalton's Atomic theory. 2. The atomic scale is reflected in the macroscopic world. 3. Energy changes and probability allow us to understand why chemicals react. 4. The 3-D structure of molecules often dictates their function.
Section 0.1
Difficulty Level: medium

49. Planets are formed after supernovas from _____ left over from the formation of a new star.

Answer: debris
Section 0.3
Difficulty Level: easy

50. The large dust clouds that formed planets were called _____.

Answer: nebula
Section 0.3
Difficulty Level: easy

51. Molecules are made of tiny particles called _____ .

Answer: atoms
Section 0.4
Difficulty Level: easy

52. There is no detectable gain or loss in mass in chemical reactions. This is the_____.

Answer: Law of Conservation of Mass
Section 0.4
Difficulty Level: easy

53. In a chemical compound, the elements are always combined in the same proportions by _____ .

Answer: mass
Section 0.4
Difficulty Level: easy

54. A compound is made of nitrogen and hydrogen in a ratio of 5.65 grams nitrogen to 1.22 grams of hydrogen. There are _____ grams of nitrogen in a sample of this compound containing 4.00 grams of hydrogen.

Answer: 18.5
Section 0.4
Difficulty Level: hard

55. A compound is made of nitrogen and hydrogen in a ratio of 22.6 grams nitrogen to 4.88 grams of hydrogen. There are _____ grams of hydrogen in a sample of the compound containing 12.6 grams of nitrogen.

Answer: 2.72
Section 0.4
Difficulty Level: hard

56. A compound of phosphorus and chlorine contains 3.00 grams of phosphorus and 10.3 grams of chlorine. There are _____ grams of phosphorus in a sample of the compound containing 17.2 grams of chlorine.

Answer: 5.01
Section 0.4
Difficulty Level: hard

57. A compound of phosphorus and chlorine contains 3.00 grams of phosphorus and 10.3 grams of chlorine. There are _____ total grams of the compound in a sample which contains 4.00 grams of chlorine.

Answer: 5.17
Section 0.4
Difficulty Level: hard

58. If 2.00 grams of hydrogen react with 16.00 grams of oxygen to form water, how many grams of water must be formed if all of the hydrogen and oxygen react?

Answer: 18.00 g
Section 0.4
Difficulty Level: medium

59. The particles found in nuclei, the protons and neutrons, are collectively called _____ .

Answer: nucleons
Section 0.5
Difficulty Level: easy

60. Which subatomic particle has a single unit of positive charge? _____

Answer: proton
Section 0.5
Difficulty Level: easy

61. How many electrons are in an atom of ^{35}Cl? _____

Answer: 17
Section 0.5
Difficulty Level: easy

62. How many nucleons are in an atom of ^{40}K? _____

Answer: 40
Section 0.5
Difficulty Level: medium

63. The element chlorine has two main isotopes that result in almost all chlorine on earth. The two are listed below with their atomic masses. The average atomic mass of chlorine is listed as 35.453 u. Using this information what is the relative abundances of the two chlorine isotopes?

Chlorine-35: 34.969 **u**
Chlorine-37: 36.966 **u**

Answer: Chlorine-35, 75.8%; Chlorine-37, 24.2%
Section 0.5
Difficulty Level: hard

64. The element bromine has two main isotopes that result in almost all bromine on earth. The two are listed below with their atomic masses. The average atomic mass of bromine is listed as 79.904 u. Using this information what is the relative abundances of the two chlorine isotopes?

Bromine-79: 78.918 **u**
Bromine-81: 80.916 **u**

Answer: Bromine-79, 50.7%; Bromine-81, 49.3%
Section 0.5
Difficulty Level: hard

True and False Questions

65. Microwave radiation observed by Penzias and Wilson in 1964 helps to support the big-bang theory because it observed microwave radiation that was characteristic of a temperature that matched the predicted temperature of the universe after heating up for 14 billion years.

Answer: False
Section 0.2
Difficulty Level: medium

66. Stars that are classified as red giants are formed after the outer layer of hydrogen in a star cools and is no longer white hot.

Answer: True
Section 0.2
Difficulty Level: medium

67. In stars the heaviest elements migrate to the outer layers of the star due to centrifugal forces.

Answer: False
Section 0.2
Difficulty Level: easy

68. Atoms are made of tiny particles called molecules.

Answer: False
Section 0.4
Difficulty Level: easy

69. In any given chemical compound, elements can be combined in various amounts by mass.

Answer: False
Section 0.4
Difficulty Level: easy

70. When a piece of paper burns in a closed container, the combined masses of the products is less than the mass of the original piece of paper.

Answer: False
Section 0.4
Difficulty Level: medium

71. Atoms must undergo disintegration followed by rearrangement, in order for chemical reactions to occur.

Answer: False
Section 0.4
Difficulty Level: medium

72. The hydrogen atom minus an electron is known as the proton.

Answer: True
Section 0.5
Difficulty Level: easy

73. Almost the entire mass of an atom is concentrated in a very large volume outside the center of the atom.

Answer: False
Section 0.5
Difficulty Level: easy

74. In a neutral atom, the number of protons must equal the number of neutrons.

Answer: False
Section 0.5
Difficulty Level: easy

75. At the nanoscale level, the structures under investigation usually have dimensions of tens to hundreds of atoms.

Answer: True
Section: *On the Cutting Edge 0.1*
Difficulty Level: medium

76. Molecular self assembly occurs when two atoms can spontaneously arrange themselves into creating a diatomic molecular structure.

Answer: False
Section: *On the Cutting Edge 0.1*
Difficulty Level: medium

77. The atomic force microscope which is used with electrically nonconducting samples, makes it possible to obtain an image of individual atoms.

Answer: True
Section: *On the Cutting Edge 0.1*
Difficulty Level: medium

78. When an electrical spark is passed through hydrogen gas, only positive ions are generated.

Answer: False
Section: *On the Cutting Edge 0.2*
Difficulty Level: medium

79. When positive ions are formed in a *mass spectrometer*, they are attracted to a positively charged metal plate that has a small hole in its center.

Answer: False
Section: *On the Cutting Edge 0.2*
Difficulty Level: medium

80. In a *mass spectrometer*, a beam of ions is sorted by the magnet into a number of beams based on the same charges that they have.

Answer: False
Section: *On the Cutting Edge 0.2*
Difficulty Level: medium

81. In a *mass spectrometer*, a beam of ions emerge from between the poles of the magnet after being sorted into an array of beams based on their masses.

Answer: True
Section: *On the Cutting Edge 0.2*
Difficulty Level: medium

82. According to recent IUPAC recommendations, a range of atomic masses should be used instead a single value.

Answer: True
Section: *On the Cutting Edge 0.3*
Difficulty Level: medium

83. Average atomic masses are used in the periodic table. These values give the true representation of mixtures of isotopes for different elements that are consistent around the world and universe.

Answer: False
Section: *On the Cutting Edge 0.3, 0.4*
Difficulty Level: medium

Critical Thinking Questions

84. What is the most logical reason for only light elements being formed during the nucleosynthesis stage of the big-bang?
    a. There were not enough neutrons and protons to produce large elements.
    b. The density of protons and neutrons was not large enough.
    c. The electrons were not present yet to form protons and neutrons to a large scale.
    d. Temperatures were still too great for a large number of protons and neutrons to stabilize into one atom.
    e. Heavy atoms were not possible yet because they weren't invented yet.

Answer: d
Section 0.2
Difficulty Level: hard

85. Assuming that most of the mass of the universe is found in stars, why is hydrogen still the most common element in the universe?

a. There were not enough neutrons and protons to produce large elements.
b. The density of protons and neutrons was not large enough.
c. The electrons were not present yet to form protons and neutrons to a large scale.
d. Temperatures in stars were still too great for a large number of protons and neutrons to stabilize into one atom.
e. Hydrogen is found in the outer layer of stars, which has the largest volume.

Answer: d
Section 0.2
Difficulty Level: medium

86. A compound of hydrogen and sulfur contains 2.69 grams of hydrogen and 47.31 grams of sulfur. Another sample of the same compound that contains 75.63 grams of sulfur would contain how many grams of hydrogen?

a. 2.69 g
b. 1.68 g
c. 0.59 g
d. 4.30 g
e. 203.4 g

Answer: d
Section 0.4
Difficulty Level: hard

87. Based on the law of Conservation of Mass, 1.2 g of elemental carbon (C) react with molecular oxygen (O_2) to produce 4.4 g of carbon dioxide gas (CO_2) as the only product. What mass of oxygen reacts?

a. 16 g
b. 1.0 g
c. 4.4 g
d. 22 g
e. 3.2 g

Answer: e
Section 0.4
Difficulty Level: medium

88. Based on the law of Conservation of Mass, 1.8 g of elemental carbon (C) react with 4.8 g of molecular oxygen (O_2) to produce carbon dioxide gas (CO_2) as the only product. What mass of carbon dioxide is formed?

a. 18 g
b. 1.9 g
c. 6.6 g
d. 12 g
e. 1.2 g

Answer: c
Section 0.4
Difficulty Level: medium

89. Based on the law of Conservation of Mass, 65.4 g of zinc metal react with exactly 32.1 g of sulfur to produce zinc sulfide (ZnS) as the only product. What mass of zinc sulfide can be formed from 10.0 g zinc metal?

a. 28 g
b. 19 g
c. 5.6 g
d. 14.9 g
e. 8.4 g

Answer: d
Section 0.4
Difficulty Level: hard

90. The major isotopes of tungsten (with abundances shown) are ^{182}W (26.32%), ^{183}W (14.31%), ^{184}W (30.67%), and ^{186}W (28.62%). What is the atomic mass of tungsten?

a. 184
b. 183
c. 190
d. 186
e. 185

Answer: a
Section 0.5
Difficulty Level: medium

91. A naturally occurring element consists of two isotopes. Calculate the average atomic mass and identify the element, based on the data below.

isotope 1:	10.013 **u**	19.78 %
isotope 2:	11.009 **u**	80.22 %

a. 10.991 **u**, neon
b. 10.81 **u**, lithium
c. 10.81 **u**, boron
d. 11.01 **u**, carbon
e. 10.81 **u**, nitrogen

Answer: c
Section 0.5
Difficulty Level: hard

92. A naturally occurring element consists of two isotopes. Calculate the fractional abundances for the two isotopes, if its average atomic mass is 107.87 **u**.

isotope 1:	106.91 **u**	?? %
isotope 2:	108.90 **u**	?? %

a. 106.91 **u**, 39.264 %; 108.90 **u**, 60.736 %
b. 106.91 **u**, 44.150 %; 108.90 **u**, 55.850 %
c. 106.91 **u**, 55.850 %; 108.90 **u**, 44.150 %
d. 106.91 **u**, 51.759 %; 108.90 **u**, 48.241 %
e. 106.91 **u**, 41.759 %; 108.90 **u**, 58.241 %

Answer: d
Section 0.5
Difficulty Level: hard

93. As expressed in On the Cutting Edge 0.3 and 0.4, different regions of the world have different isotope abundances. Many of these different distributions are based on natural processes. What does this say about different isotopes of the same element?

a. Isotopes don't mix well and some regions of the earth therefore have unmixed isotopes.
b. Different isotopes for the same elements have no similarities.
c. Although most properties of isotopes of the same element are identical, they do have some different chemical and physical properties.
d. Different isotopes for the same element have identical physical and chemical properties.
e. Isotopes of the same element cannot be isolated from each other.

Answer: d
Section: *On the Cutting Edge 0.3, 0.4*
Difficulty Level: hard