

Chemistry, 6e (McMurry/Fay)

Chapter 2 Atoms, Molecules, and Ions

2.1 Multiple-Choice Questions

- 1) According to history, the concept that all matter is composed of atoms was first proposed by
A) the Greek philosopher Democritus, but not widely accepted until modern times.
B) Dalton, but not widely accepted until the work of Mendeleev.
C) Dalton, but not widely accepted until the work of Einstein.
D) Dalton, and widely accepted within a few decades.

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

- 2) The observation that 15.0 g of hydrogen reacts with 120.0 g of oxygen to form 135.0 g of water is evidence for the law of
A) definite proportions.
B) energy conservation.
C) mass conservation.
D) multiple proportions.

Answer: C

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

- 3) The observation that 4.0 g of hydrogen reacts with 32.0 g of oxygen to form a product with O:H mass ratio = 8:1, and 6.0 g of hydrogen reacts with 48.0 g of oxygen to form the same product with O/H mass ratio = 8:1 is evidence for the law of
A) definite proportions.
B) energy conservation.
C) mass conservation.
D) multiple proportions.

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

- 4) Methane and oxygen react to form carbon dioxide and water. What mass of water is formed if 3.2 g of methane reacts with 12.8 g of oxygen to produce 8.8 g of carbon dioxide?
A) 7.2 g
B) 8.8 g
C) 14.8 g
D) 16.0 g

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

5) Sodium metal and water react to form hydrogen and sodium hydroxide. If 5.98 g of sodium react with water to form 0.26 g of hydrogen and 10.40 g of sodium hydroxide, what mass of water was consumed in the reaction?

- A) 4.68 g
- B) 5.98 g
- C) 10.14 g
- D) 10.66 g

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

6) A sample of pure lithium carbonate contains 18.8% lithium by mass. What is the % lithium by mass in a sample of pure lithium carbonate that has twice the mass of the first sample?

- A) 9.40%
- B) 18.8%
- C) 37.6%
- D) 75.2%

Answer: B

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

7) A sample of pure calcium fluoride with a mass of 15.0 g contains 7.70 g of calcium. How much calcium is contained in 45.0 g of calcium fluoride?

- A) 2.56 g
- B) 7.70 g
- C) 15.0 g
- D) 23.1 g

Answer: D

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

8) The observation that hydrogen and oxygen can react to form two compounds with different chemical and physical properties, one having an O:H mass ratio = 8:1 and the other having an O:H mass ratio = 16:1 is consistent with the law of

- A) definite proportions.
- B) energy conservation.
- C) mass conservation.
- D) multiple proportions.

Answer: D

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

9) Which of the following statements is **not** a postulate of Dalton's atomic theory?

- A) Each element is characterized by the mass of its atoms.
- B) Atoms are composed of protons, neutrons, and electrons.
- C) Chemical reactions only rearrange atomic combinations.
- D) Elements are composed of atoms.

Answer: B

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

- 10) Which of the following is a part of Dalton's atomic theory?
- A) Atoms are rearranged but not changed during a chemical reaction.
 - B) Atoms break down during radioactive decay.
 - C) Atoms contain protons, neutrons, and electrons.
 - D) Isotopes of the same element have different masses.

Answer: A

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

- 11) Which of the following is **not** explained by Dalton's atomic theory?
- A) conservation of mass during a chemical reaction
 - B) the existence of more than one isotope of an element
 - C) the law of definite proportions
 - D) the law of multiple proportions

Answer: B

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

- 12) Elements A and Q form two compounds, AQ and A₂Q₃. The mass ratio (mass Q)/(mass A) for AQ is 0.574. What is the mass ratio (mass Q)/(mass A) for A₂Q₃?
- A) 0.383
 - B) 0.861
 - C) 1.16
 - D) 2.61

Answer: B

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

- 13) Elements A and Q form two compounds, AQ and A₂Q. Which of the following must be true?
- A) (mass Q)/(mass A) is one for AQ, and 1/2 for A₂Q.
 - B) (mass Q)/(mass A) for AQ must equal (mass Q)/(mass A) for A₂Q.
 - C) (mass Q)/(mass A) for AQ must be 2 times (mass Q)/(mass A) for A₂Q.
 - D) (mass Q)/(mass A) for AQ must be 1/2 (mass Q)/(mass A) for A₂Q.

Answer: C

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

- 14) Elements A and Q form two compounds. The ratio (mass Q)/(mass A) for compound one is 0.271 and ratio (mass Q)/(mass A) for compound two is 0.362. If compound one has the chemical formula AQ, what is the chemical formula for compound two?
- A) A₃Q₄
 - B) A₂Q₃
 - C) AQ₂
 - D) AQ₃

Answer: A

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

15) The existence of electrons in atoms of all elements was demonstrated by

- A) Millikan's oil drop experiment.
- B) Rutherford's gold foil experiment.
- C) Thomson's cathode ray tube experiment.
- D) None of these

Answer: C

Topic: Section 2.3 Atomic Structure: Electrons

16) The charge-to-mass ratio of an electron was established by

- A) Millikan's oil drop experiment.
- B) Rutherford's gold foil experiment.
- C) Thomson's cathode ray tube experiment.
- D) None of these

Answer: C

Topic: Section 2.3 Atomic Structure: Electrons

17) The current model of the atom in which essentially all of an atom's mass is contained in a very small nucleus, whereas most of an atom's volume is due to the space in which the atom's electrons move was established by

- A) Millikan's oil drop experiment.
- B) Rutherford's gold foil experiment.
- C) Thomson's cathode ray tube experiment.
- D) None of these

Answer: B

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

18) The existence of neutrons in the nucleus of an atom was demonstrated by

- A) Millikan's oil drop experiment.
- B) Rutherford's gold foil experiment.
- C) Thomson's cathode ray tube experiment.
- D) None of these

Answer: D

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

19) Most of the alpha particles directed at a thin gold foil in Rutherford's experiment

- A) bounced directly back from the foil.
- B) passed directly through the foil undeflected.
- C) passed through the foil but were deflected at an angle.
- D) were absorbed by the foil.

Answer: B

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

20) Which subatomic particle has the **smallest** mass?

- A) a proton
- B) a neutron
- C) an electron
- D) an alpha particle

Answer: C

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

- 21) A proton is approximately
A) 200 times larger than an electron.
B) 2000 times larger than an electron.
C) 200 times smaller than an electron.
D) 2000 times smaller than an electron.

Answer: B

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

- 22) The symbol that is usually used to represent atomic number is _____.
A) A
B) N
C) X
D) Z

Answer: D

Topic: Section 2.5 Atomic Numbers

- 23) The mass number of an atom is equal to the number of
A) electrons.
B) neutrons.
C) protons.
D) protons plus neutrons.

Answer: D

Topic: Section 2.5 Atomic Numbers

- 24) Which of the following two atoms are isotopes?

- A) $^{40}_{18}\text{Ar}$ and $^{40}_{20}\text{Ca}$
B) $^{12}_6\text{C}$ and $^{13}_6\text{C}$
C) $^{35}_{17}\text{Cl}$ and $^{80}_{35}\text{Br}$
D) $^{24}_{12}\text{Mg}$ and $^{12}_6\text{C}$

Answer: B

Topic: Section 2.5 Atomic Numbers

- 25) Which are isotopes? An atom that has an atomic number of 34 and a mass number of 76 is an isotope of an atom that has

- A) an atomic number of 32 and a mass number of 76.
B) an atomic number of 34 and a mass number of 80.
C) 42 neutrons and 34 protons.
D) 42 protons and 34 neutrons.

Answer: B

Topic: Section 2.5 Atomic Numbers

26) Which of the following represent isotopes?

A: $\frac{25}{21}$ [] B: $\frac{21}{25}$ [] C: $\frac{27}{21}$ [] D: $\frac{25}{23}$ []

A) A and B

B) A and C

C) A and D

D) C and D

Answer: B

Topic: Section 2.5 Atomic Numbers

27) The isotope represented by $^{13}_6\text{C}$ is named

A) carbon-6

B) carbon-7

C) carbon-13

D) carbon-19

Answer: C

Topic: Section 2.5 Atomic Numbers

28) Boron-9 can be represented as

A) ^9_4Be ·

B) ^9_5B ·

C) $^{14}_5\text{B}$ ·

D) $^{14}_9\text{B}$ ·

Answer: B

Topic: Section 2.5 Atomic Numbers

29) 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

Topic: Section 2.5 Atomic Numbers

30) How many protons (p) and neutrons (n) are in an atom of calcium-46?

A) 20 p, 26 n

B) 20 p, 46 n

C) 26 p, 20 n

D) 46 p, 60 n

Answer: A

Topic: Section 2.5 Atomic Numbers

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

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

Answer: A

Topic: Section 2.5 Atomic Numbers

32) How many electrons are in a neutral atom of iodine-131?

- A) 1
- B) 53
- C) 54
- D) 131

Answer: B

Topic: Section 2.5 Atomic Numbers

33) How many protons (p), neutrons (n), and electrons (e) are in one atom of $^{23}_{12}\text{Mg}$?

- A) 12 p, 12 n, 12 e
- B) 12 p, 11 n, 12 e
- C) 12 p, 11 n, 10 e
- D) 12 p, 11 n, 14 e

Answer: B

Topic: Section 2.5 Atomic Numbers

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

- A) Br
- B) Hg
- C) Pd
- D) Se

Answer: D

Topic: Section 2.5 Atomic Numbers

35) The atoms of a particular element all have the same number of protons as neutrons. Which of the following must be true?

- A) The atomic weight must be a whole number.
- B) The mass number for each atom must equal the atomic weight of the element.
- C) The mass number must be exactly twice the atomic number for each atom.
- D) All of these are true.

Answer: C

Topic: Section 2.5 Atomic Numbers

36) The smallest sample of carbon atoms that can be observed with the naked eye has a mass of approximately 2×10^{-8} g. Given that $1 \text{ g} = 6.02 \times 10^{23} \text{ amu}$, and that carbon has an atomic weight of 12.01 amu, determine the number of carbon atoms present in the sample.

- A) 1×10^{15}
- B) 1×10^{16}
- C) 1×10^{17}
- D) 6×10^{23}

Answer: A

Topic: Section 2.6 Atomic Masses and the Mole

37) An element has two naturally occurring isotopes. One has an abundance of 37.4% and an isotopic mass of 184.953 amu, and the other has an abundance of 62.6% and a mass of 186.956 amu. What is the atomic weight of the element?

- A) 185.702 amu
- B) 185.954 amu
- C) 186.207 amu
- D) 186.956 amu

Answer: C

Topic: Section 2.6 Atomic Masses and the Mole

38) The element antimony has an atomic weight of 121.757 amu and only two naturally-occurring isotopes. One isotope has an abundance of 57.3% and an isotopic mass of 120.904 amu. Based on these data, what is the mass of the other isotope?

- A) 121.757 amu
- B) 122.393 amu
- C) 122.610 amu
- D) 122.902 amu

Answer: D

Topic: Section 2.6 Atomic Masses and the Mole

39) What is the standard isotope that is used to define the number of atoms in a mole?

- A) ^1H
- B) ^{12}C
- C) ^{16}O
- D) ^{20}Ne

Answer: B

Topic: Section 2.6 Atomic Masses and the Mole

40) The number of atoms of carbon in 12 g of carbon is closest to __.

- A) 12
- B) 10^{22}
- C) 10^{23}
- D) 10^{24}

Answer: D

Topic: Section 2.6 Atomic Masses and the Mole

41) What is the mass of one atom of the element hydrogen?

- A) 2.0 g
- B) 1.0 g
- C) 3.4×10^{-24} g
- D) 1.7×10^{-24} g

Answer: D

Topic: Section 2.6 Atomic Masses and the Mole

42) One mole of which element has the **smallest** mass?

- A) Co
- B) Cu
- C) Ni
- D) Zn

Answer: C

Topic: Section 2.6 Atomic Masses and the Mole

43) 24.0 g of which element contains the greatest number of atoms?

- A) B
- B) C
- C) N
- D) O

Answer: A

Topic: Section 2.6 Atomic Masses and the Mole

44) How many moles and how many atoms of zinc are in a sample weighing 34.9 g?

- A) 0.533 mol, 8.85×10^{-25} atoms
- B) 0.533 mol, 3.21×10^{23} atoms
- C) 1.87 mol, 3.10×10^{-24} atoms
- D) 1.87 mol, 1.13×10^{24} atoms

Answer: B

Topic: Section 2.6 Atomic Masses and the Mole

45) Which statement about nuclear reactions is true?

- A) New elements are never produced in a nuclear reaction.
- B) Nuclear reactions involve valence electrons.
- C) The rate of a nuclear reaction is affected by catalysts.
- D) Tremendous amounts of energy are involved in nuclear reactions.

Answer: D

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

46) The term "nucleons" refers to the number of _____ in the atom.

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

Answer: C

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

47) The number of nucleons in an atom or ion is the same as the

- A) atomic number.
- B) charge on the atom or ion.
- C) mass number.
- D) none of these

Answer: C

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

48) The number of nucleons in a $^{236}_{92}\text{U}^{2+}$ nucleus is

- A) 92.
- B) 144.
- C) 236.
- D) 328.

Answer: C

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

49) The number of neutrons in $^{55}_{26}\text{Fe}^{2+}$ is

- A) 26.
- B) 29.
- C) 53.
- D) 55.

Answer: B

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

50) "Isotopes" are atoms with the same number of _____ but different number of _____.

- A) electrons, protons
- B) neutrons, protons
- C) protons, electrons
- D) protons, neutrons

Answer: D

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

51) The rate of a nuclear reaction can be changed by

- A) adding a catalyst.
- B) decreasing the pressure.
- C) increasing the temperature.
- D) None of these

Answer: D

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

52) Which of the following statements is **not** correct when balancing a nuclear equation?

- I. The mass numbers must be conserved on both sides of the reaction arrow.
- II. The ionic charges must be conserved on both sides of the reaction arrow.
- III. The atomic numbers must be conserved on both sides of the reaction arrow.
- IV. The elements must be the same on both sides of the reaction arrow.

- A) II only
- B) II and III
- C) I and III
- D) II and IV

Answer: D

Topic: Section 2.8 Radioactivity

53) An alpha particle is

- A) ${}^1_1\text{H}^+$.
- B) ${}^2_1\text{H}^+$.
- C) ${}^3_1\text{H}^+$.
- D) ${}^4_2\text{He}^{2+}$.

Answer: D

Topic: Section 2.8 Radioactivity

54) When a substance decays by alpha radiation, the mass number of the nucleus _____ and the atomic number _____.

- A) increases by 4, increases by 2
- B) reduces by 4, reduces by 2
- C) increases by 2, increases by 4
- D) reduces by 2, reduces by 4

Answer: B

Topic: Section 2.8 Radioactivity

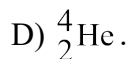
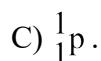
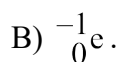
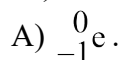
55) The nuclear decay process that involves the particle having the greatest mass is _____ emission.

- A) alpha
- B) beta
- C) gamma
- D) positron

Answer: A

Topic: Section 2.8 Radioactivity

56) A beta particle is



Answer: A

Topic: Section 2.8 Radioactivity

57) When a substance decays by beta emission, the mass number of the nucleus _____ and the atomic number _____.

A) decreases by 1, remains the same

B) increases by 1, remains the same

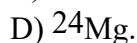
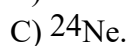
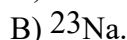
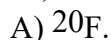
C) remains the same, decreases by 1

D) remains the same, increases by 1

Answer: D

Topic: Section 2.8 Radioactivity

58) Beta decay of ${}^{24}\text{Na}$ produces a beta particle and



Answer: D

Topic: Section 2.8 Radioactivity

59) Which of the following statements about gamma radiation is **false**?

A) It almost always accompanies alpha or beta emission.

B) It is a mechanism to release excess energy in the nucleus.

C) Gamma rays are high energy photons.

D) The mass number decreases by one with each gamma emitted.

Answer: D

Topic: Section 2.8 Radioactivity

60) Gamma radiation can be described as

A) a helium nucleus.

B) a negatively charged free electron.

C) high energy electromagnetic radiation.

D) a positively charged free electron.

Answer: C

Topic: Section 2.8 Radioactivity

61) A positron is

- A) ${}^1_0\text{n}$.
- B) ${}^1_1\text{p}$.
- C) ${}^0_1\text{e}$.
- D) ${}^0_{-1}\text{e}$.

Answer: C

Topic: Section 2.8 Radioactivity

62) Positron emission changes the atomic number of an element by

- A) -2.
- B) -1.
- C) +1.
- D) +2.

Answer: B

Topic: Section 2.8 Radioactivity

63) Which of the following statements about positrons is **false**?

- A) The positron has same mass as an electron.
- B) A positron is ejected from the nucleus during the conversion of a proton into a neutron.
- C) A positron is a positive electron.
- D) When positron emission occurs, the atomic number of the nucleus increases.

Answer: D

Topic: Section 2.8 Radioactivity

64) The nuclear transformation potassium-40 argon-40 + ? is classified as

- A) alpha emission.
- B) beta emission.
- C) electron capture.
- D) positron emission.

Answer: D

Topic: Section 2.8 Radioactivity

65) Which of the following statements about electron capture is **false**?

- A) The electron is used to convert a proton to a neutron.
- B) The electron involved is most likely an outer shell valence electron.
- C) In electron capture decay, the atomic number decreases by one.
- D) In electron capture decay, the mass number remains unchanged.

Answer: B

Topic: Section 2.8 Radioactivity

66) Which one of the following processes does **not** result in transmutation to another element?

- A) alpha emission
- B) beta emission
- C) electron capture
- D) gamma emission

Answer: D

Topic: Section 2.8 Radioactivity

67) Which of the following decay processes give a product nuclide whose atomic number is one less than the starting nuclide?

- A) alpha decay
- B) beta decay and positron decay
- C) gamma decay and beta decay
- D) positron decay and electron capture

Answer: D

Topic: Section 2.8 Radioactivity

68) Which reaction below represents $^{15}_8\text{O}$ decay by positron emission?

- A) $^{15}_8\text{O} \rightarrow {}^0_{-1}\text{e} + ^{15}_9\text{Ra}$
- B) $^{15}_8\text{O} \rightarrow {}^0_1\text{e} + ^{15}_7\text{N}$
- C) $^{15}_8\text{O} \rightarrow {}^{-1}_0\text{e} + ^{16}_8\text{O}$
- D) $^{15}_8\text{O} \rightarrow {}^1_0\text{e} + ^{14}_8\text{O}$

Answer: B

Topic: Section 2.8 Radioactivity

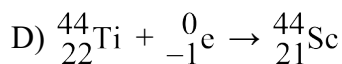
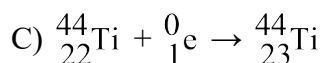
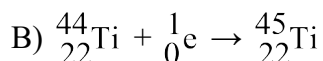
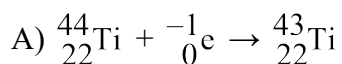
69) Which reaction below represents $^{232}_{90}\text{Th}$ decay by alpha emission?

- A) $^{232}_{90}\text{Th} \rightarrow {}^4_2\text{He} + ^{228}_{88}\text{Ra}$
- B) $^{232}_{90}\text{Th} \rightarrow {}^2_4\text{He} + ^{230}_{86}\text{Ra}$
- C) $^{232}_{90}\text{Th} \rightarrow {}^1_1\text{p} + ^{231}_{89}\text{Ac}$
- D) $^{232}_{90}\text{Th} \rightarrow {}^1_0\text{n} + ^{231}_{90}\text{Th}$

Answer: A

Topic: Section 2.8 Radioactivity

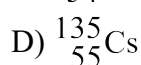
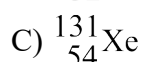
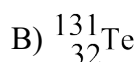
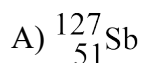
70) Which reaction below represents $^{44}_{22}\text{Ti}$ decay by electron capture?



Answer: D

Topic: Section 2.8 Radioactivity

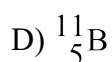
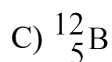
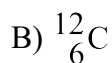
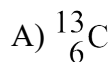
71) In addition to a beta particle, what is the other product of beta decay of $^{131}_{53}\text{I}$?



Answer: C

Topic: Section 2.8 Radioactivity

72) Tritium, ^3_1H , is formed in the upper atmosphere when $^{14}_7\text{N}$ captures a neutron and then decays. What is the other product of this reaction?



Answer: B

Topic: Section 2.8 Radioactivity

73) When more than 3000 known nuclides are plotted on a neutron/proton grid they make up a group called

A) the "island of stability."

B) the "peninsula of nuclear stability."

C) the "sea of instability."

D) none of these

Answer: B

Topic: Section 2.9 Nuclear Stability

74) Which is the only element that contains more protons than neutrons in its most abundant stable isotope?

- A) boron
- B) carbon
- C) hydrogen
- D) mercury

Answer: C

Topic: Section 2.9 Nuclear Stability

75) As the atomic number of the elements increases, the ratio of neutrons to protons in stable nuclei

- A) decreases.
- B) stays the same.
- C) increases.
- D) is unrelated to stability.

Answer: C

Topic: Section 2.9 Nuclear Stability

76) Which one of the following statements about isotopes is **false**?

- A) The ratio of neutrons to protons is about 1:1 for elements lighter than Ca.
- B) The ratio of neutrons to protons is $> 1:1$ for elements heavier than Ca.
- C) Nonradioactive isotopes generally have an odd number of neutrons.
- D) All isotopes beyond ^{209}Bi are radioactive.

Answer: C

Topic: Section 2.9 Nuclear Stability

77) Which one of the following combinations of neutrons/protons results in the **lowest** number of nonradioactive (stable) isotopes?

- A) even number protons/even number neutrons
- B) even number protons/odd number neutrons
- C) odd number protons/even number neutrons
- D) odd number protons/odd number neutrons

Answer: D

Topic: Section 2.9 Nuclear Stability

78) Which of the following elements would you expect to have the **largest** number of stable isotopes?

Element number:

- A) 48
- B) 49
- C) 50
- D) 51

Answer: C

Topic: Section 2.9 Nuclear Stability

79) Which of the following elements would be expected to be particularly stable?

- A) $^{40}_{20}\text{Ca}$
- B) $^{38}_{19}\text{K}$
- C) $^{39}_{19}\text{Ar}$
- D) $^{37}_{17}\text{Cl}$

Answer: A

Topic: Section 2.9 Nuclear Stability

80) Which process **decreases** the neutron/proton ratio?

- A) alpha emission
- B) beta emission
- C) electron capture
- D) positron emission

Answer: B

Topic: Section 2.9 Nuclear Stability

81) A radioisotope has a neutron/proton ratio which is too low. Which of the following processes will **not** occur for such a nucleus?

- A) alpha emission
- B) beta emission
- C) electron capture
- D) positron emission

Answer: B

Topic: Section 2.9 Nuclear Stability

82) A radioisotope which is neutron poor and very heavy is most likely to decay by

- A) alpha emission, electron capture, or positron emission.
- B) only alpha emission.
- C) only electron capture.
- D) only positron emission.

Answer: A

Topic: Section 2.9 Nuclear Stability

83) Which of the following nuclides is most likely to undergo beta decay?

- A) $^{190}_{80}\text{Hg}$
- B) $^{195}_{80}\text{Hg}$
- C) $^{200}_{80}\text{Hg}$
- D) $^{205}_{80}\text{Hg}$

Answer: D

Topic: Section 2.9 Nuclear Stability

84) Which of the following nuclides is most likely to decay by electron capture?

- A) $^{190}_{80}\text{Hg}$
- B) $^{195}_{80}\text{Hg}$
- C) $^{200}_{80}\text{Hg}$
- D) $^{205}_{80}\text{Hg}$

Answer: A

Topic: Section 2.9 Nuclear Stability

85) What nuclide is formed when $^{238}_{92}\text{U}$ undergoes a portion of the decay series: alpha, beta, beta, alpha, alpha, alpha.

- A) $^{226}_{88}\text{Ra}$
- B) $^{222}_{86}\text{Rn}$
- C) $^{230}_{90}\text{Th}$
- D) $^{206}_{82}\text{Pb}$

Answer: B

Topic: Section 2.9 Nuclear Stability

86) When $^{222}_{86}\text{Rn}$ decays in a 5-step series the product is $^{210}_{82}\text{Pb}$. How many alpha and beta particles are emitted in the decay series?

- A) 2 α , 3 β^-
- B) 3 α , 2 β^-
- C) 4 α , 1 β^-
- D) 1 α , 4 β^-

Answer: B

Topic: Section 2.9 Nuclear Stability

87) A banana split is an example of

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

Answer: C

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

88) Apple juice is an example of

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

Answer: D

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

89) Gold is an example of

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

Answer: B

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

90) Carbon dioxide is an example of

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

Answer: A

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

91) Steel is galvanized by giving it a surface coating of zinc. Galvanized steel is an example of

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

Answer: C

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

92) How many electrons are in the ion, Zn^{2+} ?

- A) 28
- B) 30
- C) 32
- D) 65

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

93) How many electrons are in the ion, P^{3-} ?

- A) 12
- B) 18
- C) 28
- D) 34

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

94) In which of the following sets do all species have the same number of electrons?

- 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: A

Topic: Section 2.11 Ions and Ionic Bonds

95) 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

Topic: Section 2.11 Ions and Ionic Bonds

96) 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

Topic: Section 2.11 Ions and Ionic Bonds

97) How many electrons are in the ion, CO_3^{2-} ?

- A) 16
- B) 28
- C) 30
- D) 32

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

98) In which set do all elements tend to form cations in binary ionic compounds?

- A) Li, B, O
- B) Mg, Cr, Pb
- C) N, As, Bi
- D) O, F, Cl

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

99) In which set do all elements tend to form anions in binary ionic compounds?

- A) C, S, Pb
- B) K, Fe, Br
- C) Li, Na, K
- D) N, O, I

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

100) What is the most likely charge on an ion of phosphorus, P?

- A) 5-
- B) 3-
- C) 3+
- D) 5+

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

101) Which element can form more than one kind of monatomic ion?

- A) Ca
- B) Cl
- C) Cr
- D) Cs

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

102) Which element can form more than one kind of monatomic ion?

- A) S
- B) Se
- C) Sn
- D) Sr

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

103) What type of bonding is found in the compound PCl_5 ?

- A) covalent bonding
- B) hydrogen bonding
- C) ionic bonding
- D) metallic bonding

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

104) Which one of the following compounds contains ionic bonds?

- A) CaO
- B) HF
- C) NI_3
- D) SiO_2

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

105) Which of the following is the correct chemical formula for a molecule of bromine?

- A) Br
- B) Br^-
- C) Br^+
- D) Br_2

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

106) Which of the compounds, Li_3P , PH_3 , C_2H_6 , IBr_3 , are ionic compounds?

- A) only C_2H_6
- B) only Li_3P
- C) Li_3P and PH_3
- D) PH_3 , C_2H_6 , and IBr_3

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

107) Which of the compounds, C_3H_8 , MgCl_2 , $\text{Zn}(\text{NO}_3)_2$, OCl_2 , are expected to exist as molecules?

- A) only C_3H_8
- B) C_3H_8 and OCl_2
- C) C_3H_8 , $\text{Zn}(\text{NO}_3)_2$, and OCl_2
- D) MgCl_2 and $\text{Zn}(\text{NO}_3)_2$

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

108) Which of the species below has 28 protons and 26 electrons?

- A) Fe^{2+}
- B) Ni^{2+}
- C) $^{54}_{26}\text{Fe}$
- D) $^{54}_{28}\text{Ni}$

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

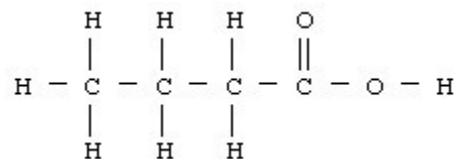
109) Which of the following elements has the **least** tendency to form an ion?

- A) Ca
- B) K
- C) Kr
- D) Se

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

110) Butyric acid has the structural formula given below.



What is the molecular or chemical formula for butyric acid?

- A) CHO
- B) C₂H₄O
- C) C₄H₈O₂
- D) C₅H₈O₃

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

111) The solid compound, Na₂CO₃, contains

- A) Na⁺, C⁴⁺, and O²⁻ ions.
- B) Na⁺ ions and CO₃²⁻ ions.
- C) Na₂⁺ and CO₃²⁻ ions.
- D) Na₂CO₃ molecules.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

112) Which of the following statements concerning ionic compounds is true?

- A) Essentially all ionic compounds are solids at room temperature and pressure.
- B) Ionic compounds do not contain any covalent bonds.
- C) Ionic compounds contain the same number of positive ions as negative ions.
- D) The chemical formula for an ionic compound must show a nonzero net charge.

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

113) The gas Freon-11, CCl₃F, contains

- A) C⁴⁺, Cl⁻, and F⁻ ions.
- B) C⁴⁺, Cl₃⁻, and F⁻ ions.
- C) C⁴⁺ and Cl₃F⁴⁻ ions.
- D) CCl₃F molecules.

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

114) The definitive distinction between ionic bonding and covalent bonding is that

- A) ionic bonding involves a sharing of electrons and covalent bonding involves a transfer of electrons.
- B) ionic bonding involves a transfer of electrons and covalent bonding involves a sharing of electrons.
- C) ionic bonding requires two nonmetals and covalent bonding requires a metal and a nonmetal.
- D) covalent bonding requires two nonmetals and ionic bonding requires a metal and a nonmetal.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

115) What is the chemical formula for iron(II) phosphate?

- A) Fe_2P
- B) Fe_2PO_4
- C) Fe_3P_2
- D) $\text{Fe}_3(\text{PO}_4)_2$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

116) What is the charge on the Cr in the ionic compound Cr_2O_3 ?

- A) 2-
- B) 1+
- C) 2+
- D) 3+

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

117) Li_2S is named

- A) lithium disulfide.
- B) lithium sulfide.
- C) lithium(II) sulfide.
- D) lithium sulfur.

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

118) What is the chemical formula for strontium hydroxide?

- A) SrH_2
- B) SrOH
- C) SrOH_2
- D) $\text{Sr}(\text{OH})_2$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

119) What is the chemical formula for strontium hydride?

- A) SrH_2
- B) SrOH
- C) SrOH_2
- D) $\text{Sr}(\text{OH})_2$

Answer: A

Topic: Section 2.12 Naming Chemical Compounds

120) The formula for dinitrogen trioxide is

- A) $\text{N}(\text{OH})_3$.
- B) $(\text{NO}_3)_2$.
- C) N_2O_3 .
- D) N_3O_2 .

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

121) The chemical formula for the sulfite ion is

- A) S^- .
- B) S^{2-} .
- C) SO_3^{2-} .
- D) SO_4^{2-} .

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

122) The chemical formula for potassium peroxide is

- A) KOH .
- B) KO_2 .
- C) K_2O .
- D) K_2O_2 .

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

123) The compound, $\text{Cu}(\text{ClO}_3)_2$, is named

- A) copper chlorate(II).
- B) copper(I) chlorate.
- C) copper(I) chlorate(II).
- D) copper(II) chlorate.

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

124) By analogy with the oxoanions of sulfur, H_2TeO_3 would be named

- A) hydrotellurous acid.
- B) pertelluric acid.
- C) telluric acid.
- D) tellurous acid.

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

125) The ions ClO_4^- , ClO_3^- , ClO_2^- , and ClO^- are named respectively

- A) hypochlorate, chlorate, chlorite, perchlorite.
- B) hypochlorite, chlorite, chlorate, perchlorate.
- C) perchlorate, chlorate, chlorite, hypochlorite.
- D) perchlorite, chlorite, chlorate, hypochlorate.

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

126) The compound, NO_2 , is named

- A) nitrate.
- B) nitrite.
- C) nitrogen dioxide.
- D) nitrogen(IV) oxide.

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

127) The ion NO_2^- is named

- A) nitrate ion.
- B) nitrite ion.
- C) nitrogen dioxide ion.
- D) nitrogen(II) oxide ion.

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

128) The chemical formula for calcium nitride is

- A) $\text{Ca}(\text{NO}_3)_2$.
- B) $\text{Ca}(\text{NO}_2)_2$.
- C) Ca_3N_2 .
- D) CaN_2 .

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

129) The thiosulfate ion is

- A) HS^- .
- B) HSO_4^{2-} .
- C) SO_5^{2-} .
- D) $\text{S}_2\text{O}_3^{2-}$.

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

130) KH_2PO_4 is

- A) hydropotassium phosphate.
- B) potassium dihydrogen phosphate.
- C) potassium diphosphate.
- D) potassium hydrogen(II) phosphate.

Answer: B

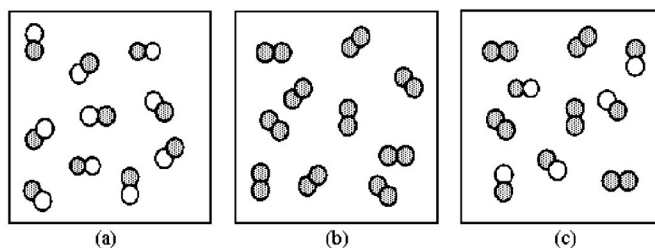
Topic: Section 2.12 Naming Chemical Compounds

131) What are the names of the ions Ba^{2+} , Sn^{2+} , and Se^{2-} ?

- A) barium, tin, and selenium
- B) barium, tin(II), and selenide
- C) barium(II), tin(II), and selenium(II-)
- D) barous, stannous, and selenide

Answer: B

Topic: Section 2.12 Naming Chemical Compounds



132) Which of the above drawings represents a pure element?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)

Answer: B

Topic: Conceptual Problems

133) Which of the above drawings represents a pure compound?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)

Answer: A

Topic: Conceptual Problems

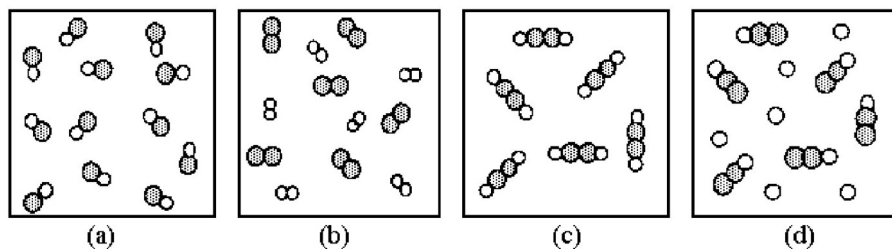
134) Which of the above drawings represents a mixture?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)

Answer: C

Topic: Conceptual Problems

135) Which of the following drawings represents a collection of acetylene (C_2H_2) molecules? The shaded spheres represent carbon atoms and the unshaded spheres represent hydrogen atoms.

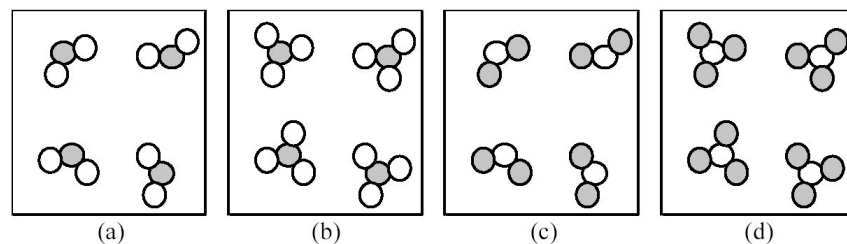


- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: C

Topic: Conceptual Problems

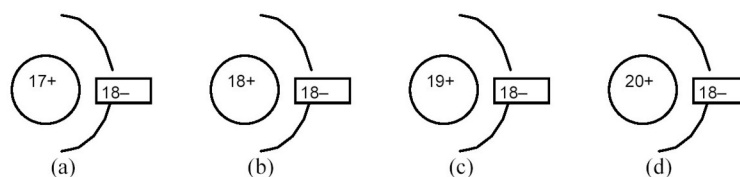
136) If unshaded spheres represent sulfur atoms and shaded spheres represent oxygen atoms, which of the following drawings depicts a collection of sulfur trioxide molecules?



- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: D

Topic: Conceptual Problems



137) Which of the above drawings represents an Ar atom?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: B

Topic: Conceptual Problems

138) Which of the above drawings represents a Cl^- ion?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: A

Topic: Conceptual Problems

139) Which of the above drawings represents a Ca^{2+} ion?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: D

Topic: Conceptual Problems

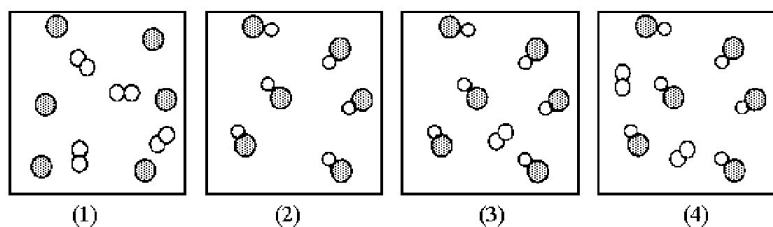
140) Which of the above drawings represents a K^+ ion?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: C

Topic: Conceptual Problems

141) Assume that the mixture of substances in drawing (1) undergoes a chemical reaction. Which of the drawings (2)-(4) represents a product mixture that is consistent with the law of mass conservation?



A) drawing (2)

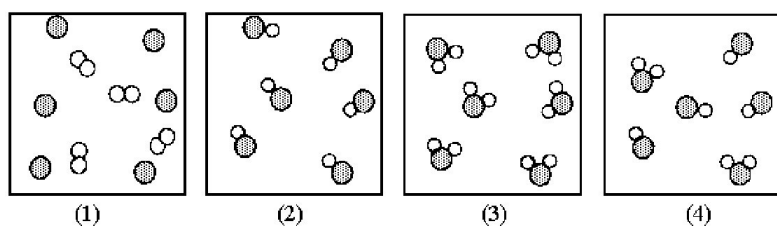
B) drawing (3)

C) drawing (4)

Answer: B

Topic: Conceptual Problems

142) Assume that the mixture of substances in drawing (1) undergoes a chemical reaction. Which of the drawings (2)-(4) represents a product mixture that is consistent with the law of mass conservation?



A) drawing (2)

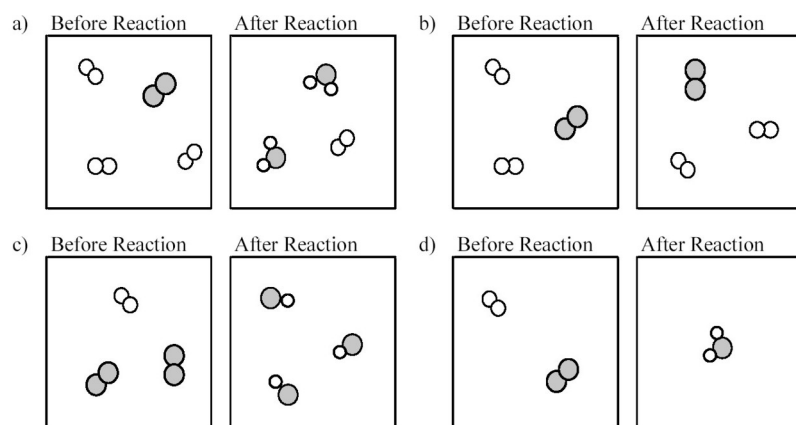
B) drawing (3)

C) drawing (4)

Answer: C

Topic: Conceptual Problems

143) Which of the following drawings depicts a chemical reaction consistent with Dalton's atomic theory?



A) drawing a)

B) drawing b)

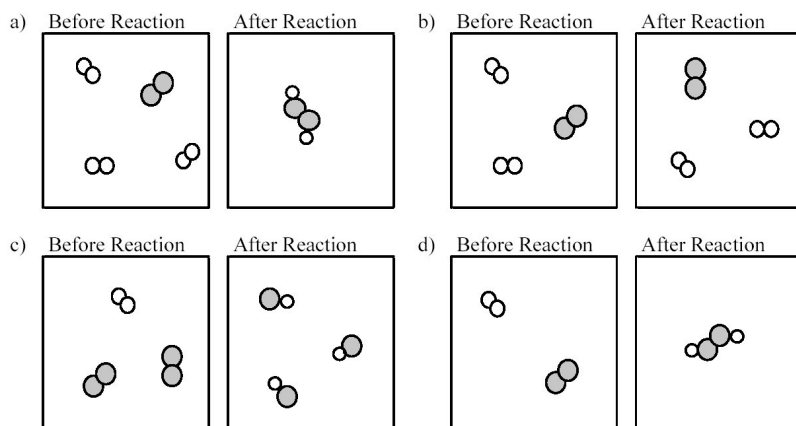
C) drawing c)

D) drawing d)

Answer: A

Topic: Conceptual Problems

144) Which of the following drawings depicts a chemical reaction consistent with Dalton's atomic theory?



A) drawing a)

B) drawing b)

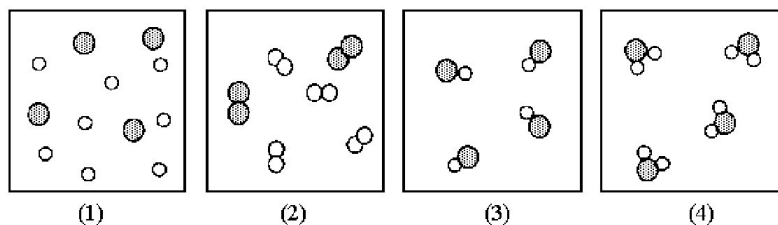
C) drawing c)

D) drawing d)

Answer: D

Topic: Conceptual Problems

145) If shaded and unshaded spheres represent atoms of different elements, as shown in drawing (1), which drawings (2)-(4) represent the law of multiple proportions?

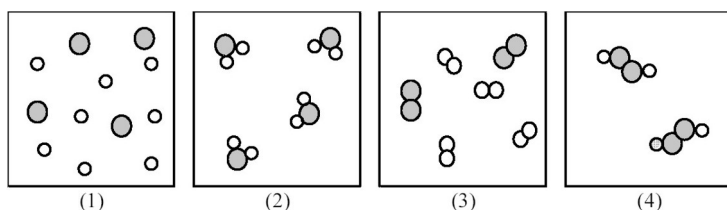


- A) only drawings (2) and (3)
- B) only drawings (2) and (4)
- C) only drawings (3) and (4)
- D) drawings (2), (3), and (4)

Answer: C

Topic: Conceptual Problems

146) If shaded and unshaded spheres represent atoms of different elements, as shown in drawing (1), which drawings (2)-(4) represent the law of multiple proportions?

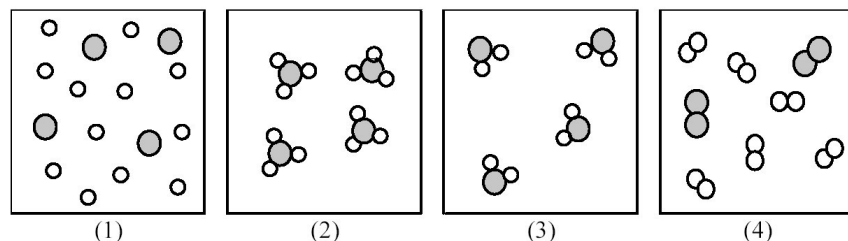


- A) only drawings (2) and (3)
- B) only drawings (2) and (4)
- C) only drawings (3) and (4)
- D) drawings (2), (3), and (4)

Answer: B

Topic: Conceptual Problems

147) If shaded and unshaded spheres represent atoms of different elements, as shown in drawing (1), which drawings (2)-(4) represent the law of multiple proportions?

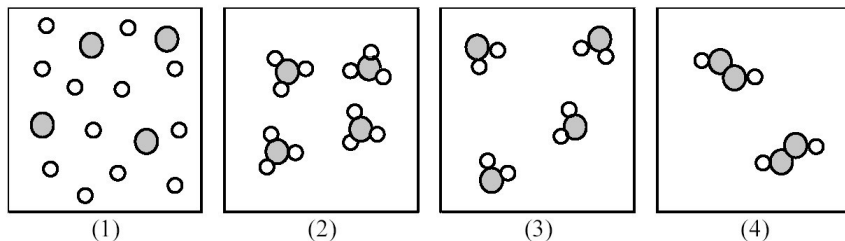


- A) only drawings (2) and (3)
- B) only drawings (2) and (4)
- C) only drawings (3) and (4)
- D) drawings (2), (3), and (4)

Answer: A

Topic: Conceptual Problems

148) If shaded and unshaded spheres represent atoms of different elements, as shown in drawing (1), which drawings (2)-(4) represent the law of multiple proportions?

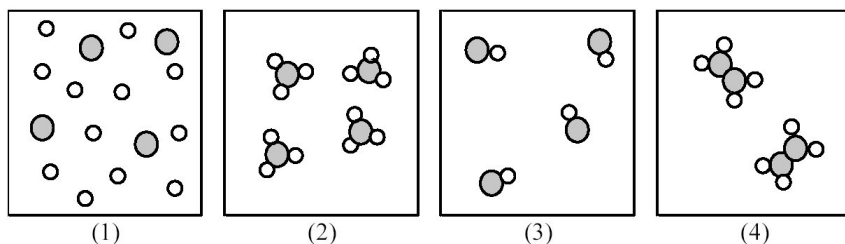


- A) only drawings (2) and (3)
- B) only drawings (2) and (4)
- C) only drawings (3) and (4)
- D) drawings (2), (3), and (4)

Answer: D

Topic: Conceptual Problems

149) If shaded and unshaded spheres represent atoms of different elements, as shown in drawing (1), which combination of drawings (2)-(4) represent the law of multiple proportions?



- A) only drawings (2) and (3)
- B) only drawings (2) and (4)
- C) only drawings (3) and (4)
- D) drawings (2), (3), and (4)

Answer: D

Topic: Conceptual Problems

150) Which of the following figures represents ${}^3_1\text{H}$? Unshaded spheres represent neutrons and shaded spheres represent protons.

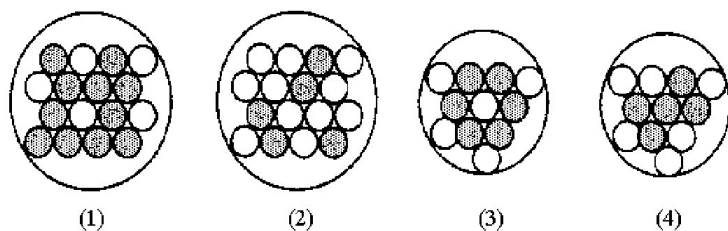


- A) figure (1)
- B) figure (2)
- C) figure (3)
- D) figure (4)

Answer: B

Topic: Conceptual Problems

151) Which of the following figures represents ${}^{11}_5\text{B}$? Unshaded spheres represent neutrons and shaded spheres represent protons.

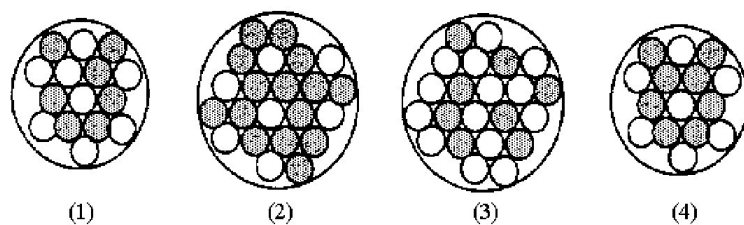


- A) figure (1)
- B) figure (2)
- C) figure (3)
- D) figure (4)

Answer: D

Topic: Conceptual Problems

152) Which of the following figures represents ${}^{15}_7\text{N}$? Unshaded spheres represent neutrons and shaded spheres represent protons.

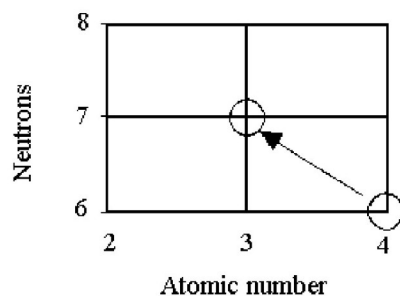


- A) figure (1)
- B) figure (2)
- C) figure (3)
- D) figure (4)

Answer: A

Topic: Conceptual Problems

153) Tell the type of decay process occurring in the following nuclear reaction.

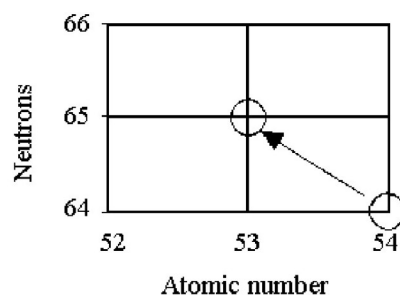


- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: D

Topic: Conceptual Problems

154) Tell the type of decay process occurring in the following nuclear reaction.

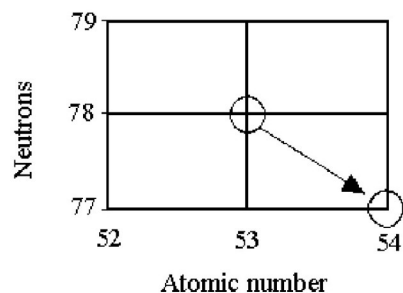


- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: D

Topic: Conceptual Problems

155) Tell the type of decay process occurring in the following nuclear reaction.

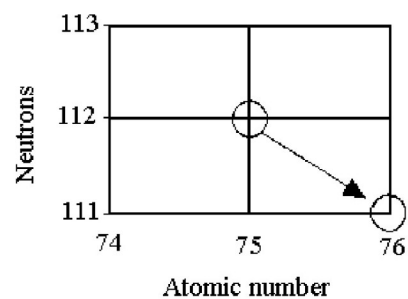


- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: B

Topic: Conceptual Problems

156) Tell the type of decay process occurring in the following nuclear reaction.

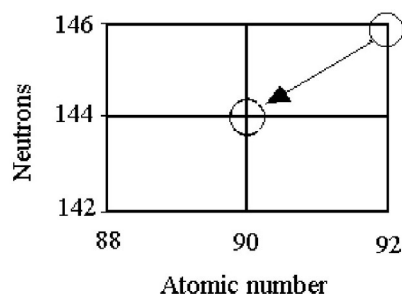


- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: B

Topic: Conceptual Problems

157) Tell the type of decay process occurring in the following nuclear reaction.

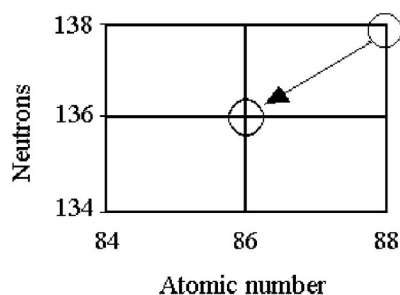


- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: A

Topic: Conceptual Problems

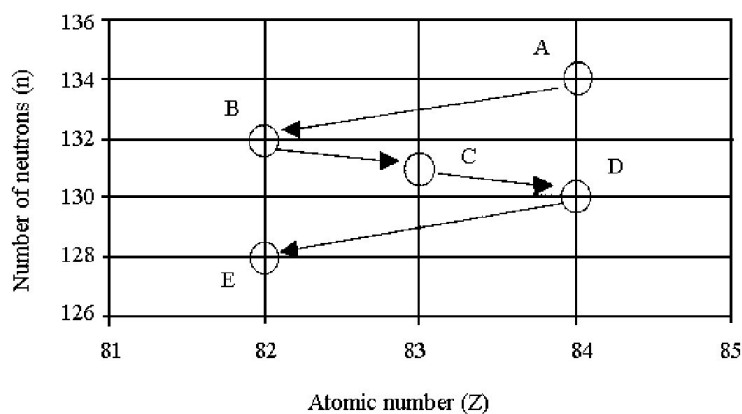
158) Tell the type of decay process occurring in the following nuclear reaction.



- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: A

Topic: Conceptual Problems



159) What kind of decay process is occurring in the decay of isotope A to isotope B in the figure shown above?

- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: A

Topic: Conceptual Problems

160) What kind of decay process is occurring in the decay of isotope B to isotope C in the figure shown above?

- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: B

Topic: Conceptual Problems

161) What kind of decay process is occurring in the decay of isotope C to isotope D in the figure shown above?

- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: B

Topic: Conceptual Problems

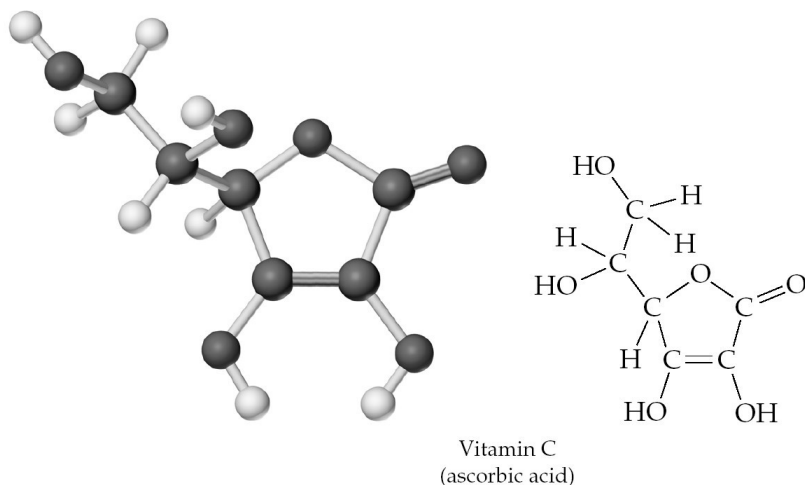
162) What kind of decay process is occurring in the decay of isotope D to isotope E in the figure shown above?

- A) α emission
- B) β emission
- C) γ emission
- D) electron capture or positron emission

Answer: A

Topic: Conceptual Problems

163) Give the molecular formula corresponding to the following ball-and-stick molecular representation of vitamin C (ascorbic acid) (gray = C, unshaded = H, black = O). In writing the formula, list the atoms in alphabetical order.

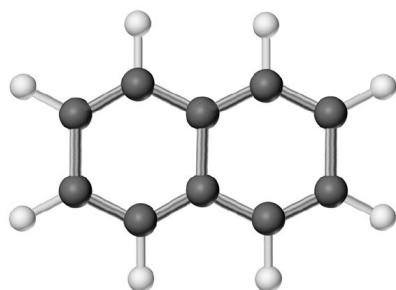


- A) CHO
- B) C₃H₄O₃
- C) C₆H₄O₆
- D) C₆H₈O₆

Answer: D

Topic: Conceptual Problems

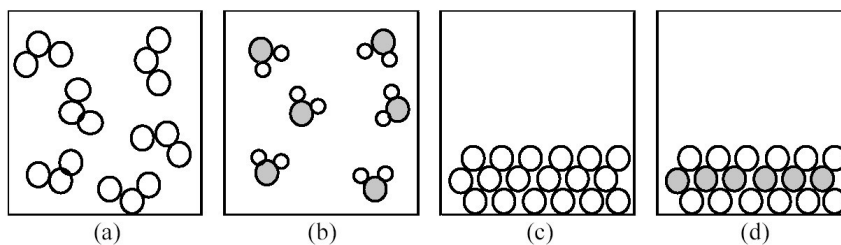
164) Give the molecular formula corresponding to the following ball-and-stick molecular representation of naphthalene (gray = C, unshaded = H). In writing the formula, list the atoms in alphabetical order.



- A) CH
- B) C₅H₄
- C) C₁₀H₈
- D) C₁₀H₁₀

Answer: C

Topic: Conceptual Problems



165) If shaded and unshaded spheres represent atoms of different elements, which of the above drawings most likely represents an ionic compound at room temperature and a pressure of 1 atm?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: D

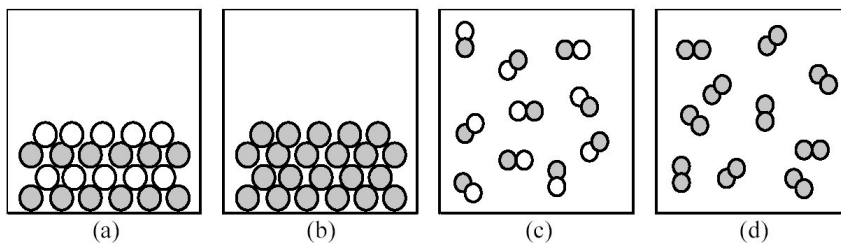
Topic: Conceptual Problems

166) If shaded and unshaded spheres represent atoms of different elements, which of the above drawings most likely represents a molecular compound at room temperature and a pressure of 1 atm?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: B

Topic: Conceptual Problems



167) If shaded and unshaded spheres represent atoms of different elements, which of the above drawings most likely represents an ionic compound at room temperature and a pressure of 1 atm?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: A

Topic: Conceptual Problems

A) drawing (a)
B) drawing (b)
C) drawing (c)
D) drawing (d)

Topic: Conceptual Problems

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

Topic: Conceptual Problems

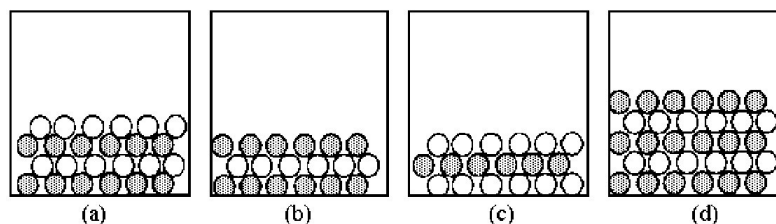
A) A and B
B) A and C
C) B and D
D) C and D

Topic: Conceptual Problems

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

Topic: Conceptual Problems

In the following drawings, shaded spheres represent cations and unshaded spheres represent anions.



172) Which drawing represents the ionic compound $\text{Mg}_3(\text{PO}_4)_2$?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: D

Topic: Conceptual Problems

173) Which drawing represents the ionic compound Na_2CO_3 ?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: B

Topic: Conceptual Problems

174) Which drawing represents the ionic compound CaCl_2 ?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: C

Topic: Conceptual Problems

175) Which drawing represents the ionic compound KNO_3 ?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: A

Topic: Conceptual Problems

176) Which drawing represents the ionic compound NH_4ClO_4 ?

- A) drawing (a)
- B) drawing (b)
- C) drawing (c)
- D) drawing (d)

Answer: A

Topic: Conceptual Problems

Use the periodic table below to answer the following questions.

A simplified periodic table grid is shown, consisting of 18 columns and 4 rows. The first column has 4 cells, the second has 3, the third has 1, and the rest of the first row has 11 cells. The second row has 17 cells. The third and fourth rows each have 18 cells. Labels A, B, C, and D are placed in the second row, first, eighth, tenth, and eleventh columns respectively.

177) Which is the correct formula of the binary fluoride of element A?

- A) AF_2
B) AF_3
C) AF_5
D) AF_6

Answer: A

Topic: Conceptual Problems

178) Which is the correct formula of the binary fluoride of element B?

- A) BF_2
B) BF_3
C) BF_5
D) BF_6

Answer: B

Topic: Conceptual Problems

179) In which pair are both formulas of binary fluorides of element C correct?

- A) CF_2 and CF_3
B) CF_2 and CF_6
C) CF_3 and CF_5
D) CF_5 and CF_6

Answer: C

Topic: Conceptual Problems

180) In which pair are both formulas of binary fluorides of element D correct?

- A) DF_2 and DF_3
 B) DF_2 and DF_6
 C) DF_3 and DF_5
 D) DF_5 and DF_6

Answer: B

Topic: Conceptual Problems

181) Which is most likely to form a binary oxide with the formula MO (where M = element A, B, C, or D)?

- A) element A
- B) element B
- C) element C
- D) element D

Answer: A

Topic: Conceptual Problems

182) Which is most likely to form a binary oxide with the formula MO_3 (where M = element A, B, C, or D)?

- A) element A
- B) element B
- C) element C
- D) element D

Answer: D

Topic: Conceptual Problems

183) Which is most likely to form a binary oxide with the formula M_2O_3 (where M = element A, B, C, or D)?

- A) element A
- B) element B
- C) element C
- D) element D

Answer: B

Topic: Conceptual Problems

184) Which is most likely to form a binary oxide with the formula M_4O_{10} (where M = element A, B, C, or D)?

- A) element A
- B) element B
- C) element C
- D) element D

Answer: C

Topic: Conceptual Problems

2.2 Algorithmic Questions

1) Methane and oxygen react to form carbon dioxide and water. What mass of water is formed if 0.80 g of methane reacts with 3.2 g of oxygen to produce 2.2 g of carbon dioxide?

- A) 1.8 g
- B) 2.2 g
- C) 3.7 g
- D) 4.0 g

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

2) Sodium metal and water react to form hydrogen and sodium hydroxide. If 5.98 g of sodium react with water to form 0.26 g of hydrogen and 10.40 g of sodium hydroxide, what mass of water was involved in the reaction?

- A) 4.68 g
- B) 5.98 g
- C) 10.14 g
- D) 10.66 g

Answer: A

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

3) A sample of pure lithium carbonate contains 18.84% lithium by mass. What is the % lithium by mass in a sample of pure lithium carbonate that has twice the mass of the first sample?

- A) 9.40%
- B) 18.8%
- C) 37.6%
- D) 75.2%

Answer: B

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

4) A sample of pure calcium fluoride with a mass of 15.0 g contains 7.70 g of calcium. How much calcium is contained in 40.0 g of calcium fluoride?

- A) 2.27 g
- B) 7.70 g
- C) 15.0 g
- D) 20.5 g

Answer: D

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

5) Elements A and Q form two compounds, AQ and A₂Q₃. The mass ratio (mass Q)/(mass A) for AQ is 0.291. What is the mass ratio (mass Q)/(mass A) for A₂Q₃?

- A) 0.194
- B) 0.436
- C) 2.29
- D) 5.15

Answer: B

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

6) Which are isotopes? 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

Topic: Section 2.5 Atomic Numbers

7) Which of the following represent isotopes?

A: $\frac{32}{15}$ [] B: $\frac{32}{16}$ [] C: $\frac{31}{15}$ [] D: $\frac{34}{17}$ []

A) A and B

B) A and C

C) A and D

D) C and D

Answer: B

Topic: Section 2.5 Atomic Numbers

8) 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

Topic: Section 2.5 Atomic Numbers

9) 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

Topic: Section 2.5 Atomic Numbers

10) 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

Topic: Section 2.5 Atomic Numbers

11) How many electrons are in a neutral atom of bromine-81?

A) 1

B) 35

C) 36

D) 81

Answer: B

Topic: Section 2.5 Atomic Numbers

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

- A) Br
- B) Hg
- C) Pd
- D) Se

Answer: D

Topic: Section 2.5 Atomic Numbers

13) The number of nucleons in a ${}^{234}_{90}\text{Th}$ nucleus is

- A) 90.
- B) 144.
- C) 234.
- D) 324.

Answer: C

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

14) Beta decay of ${}^{32}\text{P}$ produces a beta particle and

- A) ${}^{28}\text{Al}$.
- B) ${}^{31}\text{P}$.
- C) ${}^{32}\text{Si}$.
- D) ${}^{32}\text{S}$.

Answer: D

Topic: Section 2.8 Radioactivity

15) In addition to a beta particle, what is the other product of beta decay of ${}^{131}_{53}\text{I}$?

- A) ${}^{127}_{51}\text{Sb}$
- B) ${}^{131}_{52}\text{Te}$
- C) ${}^{131}_{54}\text{Xe}$
- D) ${}^{135}_{55}\text{Cs}$

Answer: C

Topic: Section 2.8 Radioactivity

16) Which of the following elements would be expected to be particularly stable?

- A) ${}^{16}_8\text{O}$
- B) ${}^{14}_7\text{N}$
- C) ${}^{15}_6\text{C}$
- D) ${}^{13}_5\text{B}$

Answer: A

Topic: Section 2.9 Nuclear Stability

17) Which of the following nuclides is most likely to undergo beta decay?

- A) $^{190}_{80}\text{Hg}$
- B) $^{195}_{80}\text{Hg}$
- C) $^{200}_{80}\text{Hg}$
- D) $^{205}_{80}\text{Hg}$

Answer: D

Topic: Section 2.9 Nuclear Stability

18) Which nuclide below is most likely to decay by electron capture?

- A) $^{176}_{74}\text{W}$
- B) $^{180}_{74}\text{W}$
- C) $^{184}_{74}\text{W}$
- D) $^{188}_{74}\text{W}$

Answer: A

Topic: Section 2.9 Nuclear Stability

19) Crude oil is an example of

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

Answer: C

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

20) Gasoline is an example of

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

Answer: D

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

21) Gold is an example of

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

Answer: B

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

22) Ammonia is an example of

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

Answer: A

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

23) In which set do all elements tend to form cations in binary ionic compounds?

- A) K, Ga, O
- B) Sr, Ni, Hg
- C) N, P, Bi
- D) O, Br, I

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

24) How many electrons are in the ion, Cu^{2+} ?

- A) 27
- B) 29
- C) 31
- D) 64

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

25) How many electrons are in the ion, P^{3-} ?

- A) 12
- B) 18
- C) 28
- D) 34

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

26) 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

Topic: Section 2.11 Ions and Ionic Bonds

27) In which of the following sets do all species have the same number of protons?

- A) F^- , Ne, Mg^{2+}
- B) Ge, Se^{2-} , Br^-
- C) K^+ , Rb^+ , Cs^+
- D) Br, Br^- , Br^+

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

28) 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

Topic: Section 2.11 Ions and Ionic Bonds

29) How many electrons are in the ion, PO_4^{3-} ?

- A) 26
- B) 44
- C) 47
- D) 50

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

30) In which set do all elements tend to form anions in binary ionic compounds?

- A) C, S, Pb
- B) K, Fe, Br
- C) Li, Na, K
- D) N, O, I

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

31) What type of bonding is found in the compound OF_2 ?

- A) covalent bonding
- B) hydrogen bonding
- C) ionic bonding
- D) metallic bonding

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

32) Which one of the following compounds contains ionic bonds?

- A) SrO
- B) HBr
- C) PBr_3
- D) SiO_2

Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

33) Which of the following is the correct chemical formula for a molecule of astatine?

- A) At
- B) At^-
- C) At^+
- D) At_2

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

34) Which of the compounds, Li_3N , NH_3 , C_3H_8 , IF_3 are ionic compounds?

- A) only C_3H_8
- B) only Li_3N
- C) Li_3N and NH_3
- D) NH_3 , C_3H_8 , and IF_3

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

35) Which of the compounds CH_4 , SrCl_2 , $\text{Cr}(\text{NO}_3)_3$, XeF_2 are expected to exist as molecules?

- A) only CH_4
- B) CH_4 and XeF_2
- C) CH_4 , $\text{Cr}(\text{NO}_3)_2$, and XeF_2
- D) SrCl_2 and $\text{Cr}(\text{NO}_3)_2$

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

36) Which of the following elements has the **least** tendency to form an ion?

- A) Ca
- B) K
- C) Kr
- D) Se

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

37) The solid compound, $\text{Mg}(\text{NO}_3)_2$, contains

- A) Mg^{2+} , N^{5+} , and O^{2-} ions.
- B) Mg^{2+} ions and NO_3^{2-} ions.
- C) Mg^{2+} and NO_3^{2-} ions.
- D) $\text{Mg}(\text{NO}_3)_2$ molecules.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

38) What is the chemical formula for iron(III) sulfate?

- A) Fe_3S
- B) Fe_3SO_4
- C) Fe_2S_3
- D) $\text{Fe}_2(\text{SO}_4)_3$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

39) What is the charge on the Cr ions in Cr_2O_3 ?

- A) 2-
- B) 1+
- C) 2+
- D) 3+

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

40) Rb_2S is named

- A) rubidium disulfide.
- B) rubidium sulfide.
- C) rubidium(II) sulfide.
- D) rubidium sulfur.

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

41) What is the chemical formula for calcium hydroxide?

- A) CaH_2
- B) CaOH
- C) CaOH_2
- D) $\text{Ca}(\text{OH})_2$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

42) What is the chemical formula for magnesium hydride?

- A) MgH_2
- B) MgOH
- C) MgOH_2
- D) $\text{Mg}(\text{OH})_2$

Answer: A

Topic: Section 2.12 Naming Chemical Compounds

43) An aqueous solution of H_2S is named

- A) hydrosulfuric acid.
- B) hydrosulfurous acid.
- C) sulfuric acid.
- D) sulfurous acid.

Answer: A

Topic: Section 2.12 Naming Chemical Compounds

44) The chemical formula for the sulfite ion is

- A) S^- .
- B) S^{2-} .
- C) SO_3^{2-} .
- D) SO_4^{2-} .

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

45) The chemical formula for lithium peroxide is

- A) LiOH.
- B) LiO₂.
- C) Li₂O.
- D) Li₂O₂.

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

46) The compound, Cu(IO₃)₂, is named

- A) copper iodate(II).
- B) copper(I) iodate.
- C) copper(I) iodate(II).
- D) copper(II) iodate.

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

47) The compound, SO₃, is named

- A) sulfate.
- B) sulfite.
- C) sulfur trioxide.
- D) sulfur (VI) oxide.

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

48) The ion, IO₂⁻, is named

- A) iodate ion.
- B) iodite ion.
- C) iodine dioxide ion.
- D) iodine(II) oxide ion.

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

49) The chemical formula for nitrous acid is

- A) H₃N(aq).
- B) H NO₂(aq).
- C) H NO₃(aq).
- D) H₂N₂O₆(aq).

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

50) The chemical formula for calcium nitride is

A) $\text{Ca}(\text{NO}_3)_2$.

B) $\text{Ca}(\text{NO}_2)_2$.

C) Ca_3N_2 .

D) CaN_2 .

Answer: C

Topic: Section 2.12 Naming Chemical Compounds

2.3 Short Answer Questions

1) In the reaction $\text{HBr} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaBr}$, If 81 g HBr react with 40 g of NaOH to produce 18 g of H_2O , the number of grams of NaBr produced is _____.

Answer: 103 g

Topic: Section 2.1 The Conservation of Mass and the Law of Definite Proportions

2) According to the law of multiple proportions, if 12 g of carbon combine with 16 g of oxygen to form CO, the number of grams of carbon that combine with 16 g of oxygen in the formation of CO_2 is _____.

Answer: 6 g

Topic: Section 2.2 The Law of Multiple Proportions and Dalton's Atomic Theory

3) The charge to mass ratio of an electron was determined from Rutherford's cathode-ray tube experiment to be $1.759 \times 10^8 \text{ C/g}$ and the charge on a single electron was determined from the Millikan oil drop experiment to be $1.602 \times 10^{-19} \text{ C}$, so the mass of a single electron is _____.

Answer: $9.11 \times 10^{-28} \text{ g}$

Topic: Section 2.3 Atomic Structure: Electrons

4) The subatomic particles contained in the nucleus of an atom are _____ and _____.

Answer: protons, neutrons

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

5) Atoms of the same element always have the same number of _____ in their nuclei.

Answer: protons

Topic: Section 2.5 Atomic Numbers

6) Isotopes have the same number of _____ but different numbers of _____ in their nuclei.

Answer: protons, neutrons

Topic: Section 2.5 Atomic Numbers

7) The symbol of the isotope having $Z = 88$ and $A = 226$ is _____.

Answer: $^{226}_{88}\text{Ra}$

Topic: Section 2.5 Atomic Numbers

8) The symbol for technetium-98 is _____.

Answer: $^{98}_{43}\text{Tc}$

Topic: Section 2.5 Atomic Numbers

9) The number of neutrons in a neutral atom of uranium-238 is _____.

Answer: 146

Topic: Section 2.5 Atomic Numbers

10) A neutral atom with atomic number 5 and mass number 11 contains _____ electrons.

Answer: 5

Topic: Section 2.5 Atomic Numbers

11) Chlorine has two common isotopes, chlorine-35 and chlorine-37, and an atomic mass of 35.45 amu. The natural abundance of chlorine-35 is _____ (greater than, less than, the same as) the natural abundance of chlorine-37.

Answer: greater than

Topic: Section 2.6 Atomic Masses and the Mole

12) The number of atoms in 23 g of Na is _____ (greater than, less than, the same as) the number of atoms in 12 g of C.

Answer: the same as

Topic: Section 2.6 Atomic Masses and the Mole

13) To the nearest whole number, the number of grams of Ba in 3.25 mol of Ba is _____.

Answer: 446 g

Topic: Section 2.6 Atomic Masses and the Mole

14) The number of moles of Li in 34.7 g Li is _____.

Answer: 5.00 mol

Topic: Section 2.6 Atomic Masses and the Mole

15) The number of protons, neutrons, and total nucleons in $^{106}_{44}\text{Ru}$ are _____, _____, and _____, respectively.

Answer: 44, 62, 106

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

16) The missing reactant in the nuclear reaction $? \rightarrow {}^{14}_7\text{N} + {}^0_{-1}\text{e}$ is _____.

Answer: ${}^{14}_6\text{C}$

Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

17) In a nuclear reaction, the symbol for a beta particle is _____.

Answer: ${}^0_{-1}\text{e}$ or β^-

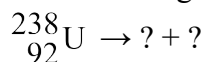
Topic: Section 2.8 Radioactivity

18) In a nuclear reaction ${}^4_2\text{He}$ is the symbol for _____.

Answer: an alpha particle

Topic: Section 2.8 Radioactivity

19) ${}^{238}_{92}\text{U}$ undergoes alpha decay producing one alpha particle and a single nuclide. To balance the equation, _____ and _____ must be added to the right side of the equation below.



Answer: ${}^{234}_{90}\text{Th}$, ${}^4_2\text{He}$

Topic: Section 2.8 Radioactivity

20) In an electron capture reaction a proton is converted into a _____.

Answer: neutron

Topic: Section 2.8 Radioactivity

21) Nuclei that are in the band of stability have a neutron/proton ratio _____ (equal to, greater than, less than) 1:1.

Answer: greater than

Topic: Section 2.9 Nuclear Stability

22) 10% saline solution (sodium chloride dissolved in water) is an example of a _____ mixture.

Answer: homogeneous

Topic: Section 2.10 Mixtures and Chemical Compounds: Molecules and Covalent Bonds

23) The number of electrons in the ion Ca^{2+} is _____.

Answer: 18

Topic: Section 2.11 Ions and Ionic Bonds

24) The number of electrons in the ion C^{4-} is _____.

Answer: 10

Topic: Section 2.11 Ions and Ionic Bonds

25) The bonding in MgO is _____, whereas the bonding in CO is _____.

Answer: ionic, covalent

Topic: Section 2.11 Ions and Ionic Bonds

26) Phosphate ion has the formula _____.

Answer: PO_4^{3-}

Topic: Section 2.12 Naming Chemical Compounds

27) The formula of iron(III) oxide contains _____ iron(III) and _____ oxide ions.

Answer: 2, 3

Topic: Section 2.12 Naming Chemical Compounds