2.1 Multiple-Choice Questions

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

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

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

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

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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

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

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

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

Which of the following statements is not a postulate of Dalton's atomic theory?
Each element is characterized by the mass of its atoms.
Atoms are composed of protons, neutrons, and electrons.
Chemical reactions only rearrange atomic combinations.
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

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

Elements A and Q form two compounds, AQ and A\(\text{2}Q\text{3}\). The mass ratio \(\text{mass Q}/(\text{mass A})\) for AQ is 0.574. What is the mass ratio \(\text{mass Q}/(\text{mass A})\) for A\(\text{2}Q\text{3}\)?
   A) 0.383
   B) 0.861
   C) 1.16
   D) 2.61
   Answer: B

Elements A and Q form two compounds, AQ and A\(\text{2}Q\). Which of the following must be true?
   A) \(\text{mass Q}/(\text{mass A})\) is one for AQ, and \(1/2\) for A\(\text{2}Q\).
   B) \(\text{mass Q}/(\text{mass A})\) for AQ must equal \(\text{mass Q}/(\text{mass A})\) for A\(\text{2}Q\).
   C) \(\text{mass Q}/(\text{mass A})\) for AQ must be 2 times \(\text{mass Q}/(\text{mass A})\) for A\(\text{2}Q\).
   D) \(\text{mass Q}/(\text{mass A})\) for AQ must be \(1/2\) \(\text{mass Q}/(\text{mass A})\) for A\(\text{2}Q\).
   Answer: C

Elements A and Q form two compounds. The ratio \(\text{mass Q}/(\text{mass A})\) for compound one is 0.271 and ratio \(\text{mass Q}/(\text{mass A})\) for compound two is 0.362. If compound one has the chemical formula AQ, what is the chemical formula for compound two?
   A) A\(\text{3}Q\text{4}\)
   B) A\(\text{2}Q\text{3}\)
   C) AQ
   D) A\(Q\text{3}\)
   Answer: A
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

The charge-to-mass ratio of an electron was established by
Millikan's oil drop experiment.
Rutherford's gold foil experiment.
Thomson's cathode ray tube experiment.
None of these
Answer: C

Topic: Section 2.3 Atomic Structure: Electrons

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

The existence of neutrons in the nucleus of an atom was demonstrated by
Millikan's oil drop experiment.
Rutherford's gold foil experiment.
Thomson's cathode ray tube experiment.
None of these
Answer: D

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

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

Which subatomic particle has the smallest mass?
a proton
a neutron
an electron
an alpha particle
Answer: C

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

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21) A proton is approximately
   200 times larger than an electron.
   2000 times larger than an electron.
   200 times smaller than an electron.
   2000 times smaller than an electron. Answer: B
   Topic: Section 2.4 Atomic Structure: Protons and Neutrons
   
   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
   
   The mass number of an atom is equal to the number of
   electrons.
   neutrons.
   protons.
   protons plus neutrons.
   Answer: D
   Topic: Section 2.5 Atomic Numbers
   
   Which of the following two atoms are isotopes?
   40Ar and 40Ca
   A) 18Ar and 20Ca
   B) 6C and 6C
   1213
   3580
   1712
   6C 35Br
   12 Mg
   Answer: B
   Topic: Section 2.5 Atomic Numbers
   
   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: \( ^{25}_{21} \)  
B: \( ^{21}_{25} \)  
C: \( ^{27}_{21} \)  
D: \( ^{25}_{23} \)
A and B  
A and C  
A and D  
C and D
Answer: B  
Topic: Section 2.5 Atomic Numbers

27) The isotope represented by \( ^{13}_{6} \) is named
- carbon-6  
- carbon-7  
- carbon-13  
- carbon-19
Answer: C  
Topic: Section 2.5 Atomic Numbers

Boron-9 can be represented as
A) \( ^{4}_{9} \) Be  
B) \( ^{9}_{5} \) B  
C) \( ^{14}_{5} \) B  
D) \( ^{14}_{9} \) B
Answer: B  
Topic: Section 2.5 Atomic Numbers

29) How many protons (p) and neutrons (n) are in an atom of \( ^{90}_{38} \) Sr?  
- 38 p, 52 n  
- 38 p, 90 n  
- 52 p, 38 n  
- 90 p, 38 n
Answer: A  
Topic: Section 2.5 Atomic Numbers

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
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

How many electrons are in a neutral atom of iodine-131?
1
53
54
131
Answer: B
Topic: Section 2.5 Atomic Numbers

33) How many protons (p), neutrons (n), and electrons (e) are in one atom of $^{12}_{23}$ Mg?
12 p, 12 n, 12 e
12 p, 11 n, 12 e
12 p, 11 n, 10 e
12 p, 11 n, 14 e
Answer: B
Topic: Section 2.5 Atomic Numbers

34) Identify the chemical symbol of element Q in $^{80}_{34}$ Q.
Br
Hg
Pd
Se
Answer: D
Topic: Section 2.5 Atomic Numbers

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 $2 \times 10^{-8}$ 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.

\[
1 \times 10^{16} \\
1 \times 10^{17} \\
6 \times 10^{23}
\]

Answer: A

Topic: Section 2.6 Atomic Masses and the Mole

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

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

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

\[
\begin{align*}
\text{H}^1 \\
\text{C}^{12} \\
\text{O}^{16} \\
\text{Ne}^{20}
\end{align*}
\]

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 .

\[
\begin{align*}
12^{22} \\
10^{23} \\
10^{24} \\
10^{25}
\end{align*}
\]

Answer: D

Topic: Section 2.6 Atomic Masses and the Mole
What is the mass of one atom of the element hydrogen?
A) 2.0 g
B) 1.0 g
C) $3.4 \times 10^{-24}$ g
D) $1.7 \times 10^{-24}$ g
Answer: D

Topic: Section 2.6 Atomic Masses and the Mole

One mole of which element has the smallest mass?
Co
Cu
Ni
Zn
Answer: C

Topic: Section 2.6 Atomic Masses and the Mole

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

How many moles and how many atoms of zinc are in a sample weighing 34.9 g?
A) 0.533 mol, $8.85 \times 10^{23}$ atoms
B) 0.533 mol, $3.21 \times 10^{24}$ atoms
C) 1.87 mol, $3.10 \times 10^{24}$ atoms
D) 1.87 mol, $1.13 \times 10^{24}$ atoms
Answer: B

Topic: Section 2.6 Atomic Masses and the Mole

45) Which statement about nuclear reactions is true?
New elements are never produced in a nuclear reaction.
Nuclear reactions involve valence electrons.
The rate of a nuclear reaction is affected by catalysts.
Tremendous amounts of energy are involved in nuclear reactions. Answer: D

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

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
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

The number of nucleons in a $^{236}_{92}U^{2+}$ nucleus is
92.
144.
236.
328.
Answer: C

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

49) The number of neutrons in $^{55}_{26}Fe^{2+}$ is
26.
29.
53.
55.
Answer: B

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

"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

The rate of a nuclear reaction can be changed by
adding a catalyst.
decreasing the pressure.
increasing the temperature.
None of these
Answer: D

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

II only

II and III

I and III

II and IV

Answer: D

Topic: Section 2.8 Radioactivity

An alpha particle is

\[ {}^1_2 \text{He}^{2+} \]

A) \[ {}^1_1 \text{H}^+ \]  
B) \[ {}^2_1 \text{H}^+ \]  
C) \[ {}^3_1 \text{H}^- \]  
D) \[ {}^4_2 \text{H}^+ \]

Answer: D

Topic: Section 2.8 Radioactivity

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

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
A beta particle is

A) $-1e$.
B) $0e$.
C) $1p$.

Answer: A

Topic: Section 2.8 Radioactivity

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

Beta decay of $^{24}_{11}$Na produces a beta particle and $^{20}_{17}$F.

Answer: D

Topic: Section 2.8 Radioactivity

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

Gamma radiation can be described as
a helium nucleus.
a negatively charged free electron.
a positively charged free electron. Answer: C

Topic: Section 2.8 Radioactivity
A positron is

$$\begin{align*}
A) & 0^1n. \\
B) & 1^p. \\
C) & 0^e. \\
D) & -1^e. \\
\end{align*}$$

Answer: C

Topic: Section 2.8 Radioactivity

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

Which of the following statements about positrons is false?

A) The positron has the 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

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

alpha emission.
beta emission.
electron capture.
positron emission.

Answer: D

Topic: Section 2.8 Radioactivity

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
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

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 $^{15}_{8}$O decay by positron emission?

\[ ^{15}_{8}\text{O} \rightarrow 0^+ _{1}e + ^{15}_{9}\text{Ra} \]
\[ ^{15}_{8}\text{O} \rightarrow 0^+ _{1}e + ^{16}_{8}\text{O} \]
Answer: B
Topic: Section 2.8 Radioactivity

Which reaction below represents $^{232}_{90}$Th decay by alpha emission?
A) $^{232}_{90}\text{Th} \rightarrow 4^+ _{2}\text{He} + ^{228}_{88}\text{Ra}$
B) $^{232}_{90}\text{Th} \rightarrow 2^+ _{4}\text{He} + ^{230}_{86}\text{Ra}$
\[ ^{232}_{90}\text{Th} \rightarrow 1^+ _{1}\text{p} + ^{231}_{89}\text{Ac} \]
\[ ^{232}_{90}\text{Th} \rightarrow 1^+ _{1}\text{n} + ^{231}_{89}\text{Ac} \]
Answer: A
Topic: Section 2.8 Radioactivity
70) Which reaction below represents $^{22}$Ti decay by electron capture?

\[
\begin{align*}
^{44}_{22}\text{Ti} + ^0_1\text{e} &\rightarrow ^{43}_{22}\text{Ti} \\
^{44}_{22}\text{Ti} + ^0_1\text{e} &\rightarrow ^{45}_{22}\text{Ti} \\
^{44}_{22}\text{Ti} + ^0_1\text{e} &\rightarrow ^{44}_{23}\text{Ti} \\
^{44}_{22}\text{Ti} + ^0_1\text{e} &\rightarrow ^{44}_{21}\text{Sc}
\end{align*}
\]

Answer: D

Topic: Section 2.8 Radioactivity

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

\[
\begin{align*}
^{127}_{51}\text{Sb} \\
^{131}_{32}\text{Te} \\
^{131}_{54}\text{Xe} \\
^{135}_{55}\text{Cs}
\end{align*}
\]

Answer: C

Topic: Section 2.8 Radioactivity

72) Tritium, $^1_3\text{H}$, 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?

\[
\begin{align*}
^{13}_{6}\text{C} \\
^{12}_{6}\text{C} \\
^{12}_{5}\text{B} \\
^{11}_{5}\text{B}
\end{align*}
\]

Answer: B

Topic: Section 2.8 Radioactivity

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
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

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

Which one of the following statements about isotopes is false?
The ratio of neutrons to protons is about 1:1 for elements lighter than Ca.
The ratio of neutrons to protons is > 1:1 for elements heavier than Ca.
Nonradioactive isotopes generally have an odd number of neutrons.
All isotopes beyond Bi are radioactive.
Answer: C
Topic: Section 2.9 Nuclear Stability

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

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

A)  

\[
_{20}^{40}\text{Ca}
\]

B)  

\[
_{19}^{39}\text{K}
\]

\[
_{19}^{37}\text{Ar}
\]

\[
_{17}^{35}\text{Cl}
\]

Answer: A

Topic: Section 2.9 Nuclear Stability

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

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

A radioisotope which is neutron poor and very heavy is most likely to decay by alpha emission, electron capture, or positron emission.

only alpha emission.
only electron capture.
only positron emission.

Answer: A

Topic: Section 2.9 Nuclear Stability

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

A)  

\[
_{19}^{190}\text{Hg}
\]

B)  

\[
_{19}^{195}\text{Hg}
\]

C)  

\[
_{20}^{200}\text{Hg}
\]

D)  

\[
_{20}^{205}\text{Hg}
\]

Answer: D

Topic: Section 2.9 Nuclear Stability
Which of the following nuclides is most likely to decay by electron capture?

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

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.

$^{226}_{88}\text{Ra}$
$^{222}_{86}\text{Rn}$
$^{230}_{90}\text{Th}$
$^{206}_{82}\text{Pb}$

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?

- 2 α, 3 β
- 3 α, 2 β
- 4 α, 1 β
- 1 α, 4 β

Answer: B

Topic: Section 2.9 Nuclear Stability

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
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

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

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

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

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

28
30
32
65
Answer: A
Topic: Section 2.11 Ions and Ionic Bonds

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
In which of the following sets do all species have the same number of electrons? A) Br\(^{2+}\), Kr, Sr
C, N\(^{3-}\), O
Mg\(^{2+}\), Sr, Ba
O, O\(^{2-}\), O\(^{2+}\)
Answer: A

Topic: Section 2.11 Ions and Ionic Bonds

In which of the following sets do all species have the same number of protons? A) Br\(^{2+}\), Kr, Sr
B) C, N\(^{3-}\), O
C) Mg\(^{2+}\), Sr\(^{2+}\), Ba
D) O, O\(^{2-}\), O
Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

What is the identity of element Q if the ion Q\(^{2+}\) contains 10 electrons?
C
O
Ne
Mg
Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

97) How many electrons are in the ion, CO\(_3\)\(^{2-}\)?
16
28
30
32
Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

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

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
What is the most likely charge on an ion of phosphorus, P?
A) 5-
B) 3-C) 3+
D) 5+
Answer: B

Which element can form more than one kind of monatomic ion?
A) Ca
B) Cl C)
Cr D) Cs
Answer: C

What type of bonding is found in the compound $\text{PCl}_5$?
covalent bonding
hydrogen bonding
ionic bonding
metallic bonding
Answer: A

Which one of the following compounds contains ionic bonds?
A) CaO
B) HF
C) Ni$_3$
D) SiO$_2$
Answer: A

Which of the following is the correct chemical formula for a molecule of bromine?
A) Br
B) Br +
Br
Br$_2$
Answer: D
Which of the compounds, Li₃P, PH₃, C₂H₆, IBr₃, are ionic compounds? A) only C₂H₆
B) only Li₃P
C) Li₃P and PH₃
PH₃, C₂H₆, and IBr₃
Answer: B
Topic: Section 2.11 Ions and Ionic Bonds

Which of the compounds, C₃H₈, MgCl₂, Zn(NO₃)₂, OCl₂, are expected to exist as molecules? A) only C₃H₈
B) C₃H₈ and OCl₂
C) C₃H₈, Zn(NO₃)₂, and OCl₂
D) MgCl₂ and Zn(NO₃)₂
Answer: B
Topic: Section 2.11 Ions and Ionic Bonds

Which of the species below has 28 protons and 26 electrons? A) Fe²⁺
B) Ni²⁺
C) Fe
D) Ni
Answer: B
Topic: Section 2.11 Ions and Ionic Bonds

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.

```
H       H       H       O
\| \| \| \|
H - C - C - C - C - O - H
\| \| \| \|
H       H       H
```

What is the molecular or chemical formula for butyric acid?

CHO
C₂H₄O
C₄H₈O₂
C₅H₈O₃

Answer: C

Topic: Section 2.11 Ions and Ionic Bonds

The solid compound, Na₂CO₃, contains A) Na⁺, C⁴⁺, and O²⁻ ions.
B) Na⁺ ions and CO₃²⁻ ions.
Na²⁺ and CO₃²⁻ ions.
Na₂CO₃ molecules.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

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

The gas Freon-11, CCl₃F, contains A) C⁺, Cl⁻, and F⁻ ions.
B) C₄⁺, Cl₃⁻, and F⁻ ions.
C⁺ and Cl₃⁻ ions.
CCl₃F molecules.

Answer: D

Topic: Section 2.11 Ions and Ionic Bonds

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

ionic bonding involves a sharing of electrons and covalent bonding involves a transfer of electrons.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds
What is the chemical formula for iron(II) phosphate? A) Fe$_2$P
B) Fe$_2$PO$_4$
C) Fe$_3$P$_2$
D) Fe$_3$(PO$_4$)$_2$
Answer: D

Topic: Section 2.12 Naming Chemical Compounds

What is the charge on the Cr in the ionic compound Cr$_2$O$_3$?

- 2-
- 1+
- 2+
- 3+

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

117) Li$_2$S is named
- lithium disulfide.
- lithium sulfide.
- lithium(II) sulfide.
- lithium sulfur.

Answer: B

Topic: Section 2.12 Naming Chemical Compounds

What is the chemical formula for strontium hydroxide? A) SrH$_2$
B) SrOH
C) SrOH$_2$
D) Sr(OH)$_2$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds

What is the chemical formula for strontium hydride? A) SrH$_2$
B) SrOH
C) SrOH$_2$
D) Sr(OH)$_2$

Answer: A

Topic: Section 2.12 Naming Chemical Compounds
The formula for dinitrogen trioxide is
A) N(OH)$_3$.
B) (NO$_3$)$_2$.
C) N$_2$O$_3$.
D) N$_3$O$_2$.
Answer: C
Topic: Section 2.12 Naming Chemical Compounds

The chemical formula for the sulfite ion is
B) S$^{2-}$.
C) S$^{2-}$.
D) SO$_3^{2-}$.
Answer: C
Topic: Section 2.12 Naming Chemical Compounds

The chemical formula for potassium peroxide is
A) KOH.
B) KO$_2$.
C) K$_2$O.
D) K$_2$O$_2$.
Answer: D
Topic: Section 2.12 Naming Chemical Compounds

123) The compound, Cu(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$_2$TeO$_3$ 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 hypochlorate, chlorate, chlorite, perchlorite.hypochlorite, chlorite, chlorate, perchlorate. perchlorate, chlorate, chlorite, hypochlorite. perchlorite, chlorite, chlorate, hypochlorate. Answer: C

Topic: Section 2.12 Naming Chemical Compounds

126) The compound, NO$_2^-$, is named nitrate. nitrite. nitrogen dioxide. nitrogen(IV) oxide. Answer: C

Topic: Section 2.12 Naming Chemical Compounds

127) The ion NO$_2^-$ is named nitrate ion. nitrite ion. nitrogen dioxide ion. nitrogen(II) oxide ion. Answer: B

Topic: Section 2.12 Naming Chemical Compounds

The chemical formula for calcium nitride is A) Ca(NO$_3$)$_2$. B) Ca(NO$_2$)$_2$. C) Ca$_3$N$_2$. D) CaN$_2$. Answer: C

Topic: Section 2.12 Naming Chemical Compounds

The thiosulfate ion is A) HS$^-$. B) HSO$_4^-$ C) SO$_5^{2-}$. D) S$_2$O$_3^-$ Answer: D

Topic: Section 2.12 Naming Chemical Compounds
130) \( \text{KH}_2\text{PO}_4 \) is
- hydropotassium phosphate.
- potassium dihydrogen phosphate.
- potassium diphosphate.
- potassium hydrogen(II) phosphate. Answer: B

**Topic: Section 2.12 Naming Chemical Compounds**

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

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**

Which of the above drawings represents a pure element?

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

Answer: B

**Topic: Conceptual Problems**

Which of the above drawings represents a pure compound?

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

Answer: A

**Topic: Conceptual Problems**

Which of the above drawings represents a mixture?

drawing (a)
drawing (b)
drawing (c)

Answer: C

**Topic: Conceptual Problems**
Which of the following drawings represents a collection of acetylene (C$_2$H$_2$) molecules? The shaded spheres represent carbon atoms and the unshaded spheres represent hydrogen atoms.

(a)  
(b)  
(c)  
(d)  

Answer: C  
Topic: Conceptual Problems

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)  
(b)  
(c)  
(d)  

Answer: D  
Topic: Conceptual Problems
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

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

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

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
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?

(1) [Image of drawing 1]
(2) [Image of drawing 2]
(3) [Image of drawing 3]
(4) [Image of drawing 4]

Answer: B

Topic: Conceptual Problems

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?

(1) [Image of drawing 1]
(2) [Image of drawing 2]
(3) [Image of drawing 3]
(4) [Image of drawing 4]

Answer: C

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

drawing a)  
drawing b)  
drawing c)  
drawing d)  

Answer: A  
Topic: Conceptual Problems

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

drawing a)  
drawing b)  
drawing c)  
drawing d)  

Answer: D  
Topic: Conceptual Problems
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?

- only drawings (2) and (3)
- only drawings (2) and (4)
- only drawings (3) and (4)
- drawings (2), (3), and (4)

Answer: C

Topic: Conceptual Problems

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?

- only drawings (2) and (3)
- only drawings (2) and (4)
- only drawings (3) and (4)
- drawings (2), (3), and (4)

Answer: B

Topic: Conceptual Problems

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?

- only drawings (2) and (3)
- only drawings (2) and (4)
- only drawings (3) and (4)
- drawings (2), (3), and (4)

Answer: A

Topic: Conceptual Problems
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?

- only drawings (2) and (3)
- only drawings (2) and (4)
- only drawings (3) and (4)
- drawings (2), (3), and (4)

Answer: D
Topic: Conceptual Problems

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?

- only drawings (2) and (3)
- only drawings (2) and (4)
- only drawings (3) and (4)
- drawings (2), (3), and (4)

Answer: D
Topic: Conceptual Problems

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

- figure (1)
- figure (2)
- figure (3)
- figure (4)

Answer: B
Topic: Conceptual Problems
Which of the following figures represents $^{11}_5$B? Unshaded spheres represent neutrons and shaded spheres represent protons.

figure (1)  
figure (2)  
figure (3)  
figure (4)  
Answer: D  
Topic: Conceptual Problems

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

figure (1)  
figure (2)  
figure (3)  
figure (4)  
Answer: A  
Topic: Conceptual Problems
153) Tell the type of decay process occurring in the following nuclear reaction.

- α emission
- β emission
- γ emission
- electron capture or positron emission

Answer: D
Topic: Conceptual Problems

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

- α emission
- β emission
- γ emission
- electron capture or positron emission

Answer: D
Topic: Conceptual Problems
155) Tell the type of decay process occurring in the following nuclear reaction.

Answer: B

Topic: Conceptual Problems

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

Answer: B

Topic: Conceptual Problems
157) Tell the type of decay process occurring in the following nuclear reaction.

\[ \begin{array}{c}
\text{α emission} \\
\text{β emission} \\
\text{γ emission} \\
\text{electron capture or positron emission}
\end{array} \]

Answer: A

Topic: Conceptual Problems

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

\[ \begin{array}{c}
\text{α emission} \\
\text{β emission} \\
\text{γ emission} \\
\text{electron capture or positron emission}
\end{array} \]

Answer: A

Topic: Conceptual Problems
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

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

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

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
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.

CHO
C₃H₄O₃
C₆H₄O₆
C₆H₈O₆

Answer: D
Topic: Conceptual Problems

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.

CH
C₅H₄
C₁₀H₈
C₁₀H₁₀

Answer: C
Topic: Conceptual Problems
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

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

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
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: C
Topic: Conceptual Problems

Use the periodic table below to answer the following questions.

Which elements commonly form anions?
A) A and B  
B) A and C  
C) B and D  
D) C and D
Answer: D
Topic: Conceptual Problems

Which elements commonly form cations?
A) A and B  
B) A and C  
C) B and D  
D) C and D
Answer: A
Topic: Conceptual Problems

Which elements commonly form covalent bonds?
A) A and B  
B) A and C  
C) B and D  
D) C and D
Answer: D
Topic: Conceptual Problems
In the following drawings, shaded spheres represent cations and unshaded spheres represent anions.

172) Which drawing represents the ionic compound \( \text{Mg}_3\text{(PO}_4\text{)}_2 \)?
   drawing (a)  
   drawing (b)  
   drawing (c)  
   drawing (d)  
Answer: D  
Topic: Conceptual Problems

173) Which drawing represents the ionic compound \( \text{Na}_2\text{CO}_3 \)?
   drawing (a)  
   drawing (b)  
   drawing (c)  
   drawing (d)  
Answer: B  
Topic: Conceptual Problems

174) Which drawing represents the ionic compound \( \text{CaCl}_2 \)?
   drawing (a)  
   drawing (b)  
   drawing (c)  
   drawing (d)  
Answer: C  
Topic: Conceptual Problems

175) Which drawing represents the ionic compound \( \text{KNO}_3 \)?
   drawing (a)  
   drawing (b)  
   drawing (c)  
   drawing (d)  
Answer: A  
Topic: Conceptual Problems

176) Which drawing represents the ionic compound \( \text{NH}_4\text{ClO}_4 \)?
   drawing (a)  
   drawing (b)  
   drawing (c)  
   drawing (d)  
Answer: A  
Topic: Conceptual Problems
Use the periodic table below to answer the following questions.

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

A) \(\text{AF}_2\)
B) \(\text{AF}_3\)
C) \(\text{AF}_5\)
D) \(\text{AF}_6\)

Answer: A

Topic: Conceptual Problems

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

A) \(\text{BF}_2\)
B) \(\text{BF}_3\)
C) \(\text{BF}_5\)
D) \(\text{BF}_6\)

Answer: B

Topic: Conceptual Problems

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

A) \(\text{CF}_2\) and \(\text{CF}_3\)
B) \(\text{CF}_2\) and \(\text{CF}_6\)
C) \(\text{CF}_3\) and \(\text{CF}_5\)
D) \(\text{CF}_5\) and \(\text{CF}_6\)

Answer: C

Topic: Conceptual Problems

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

A) \(\text{DF}_2\) and \(\text{DF}_3\)
B) \(\text{DF}_2\) and \(\text{DF}_6\)
C) \(\text{DF}_3\) and \(\text{DF}_5\)
D) \(\text{DF}_5\) and \(\text{DF}_6\)

Answer: B

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

Which is most likely to form a binary oxide with the formula MO$_3$ (where M = element A, B, C, or D)?
A) element
B) element
C) element
D) element
Answer: D

183) Which is most likely to form a binary oxide with the formula M$_2$O$_3$ (where M = element A, B, C, or D)?
A) element
B) element
C) element
D) element
Answer: B

184) Which is most likely to form a binary oxide with the formula M$_4$O$_{10}$ (where M = element A, B, C, or D)?
A) element
B) element
C) element
D) element
Answer: C

2.2 Algorithmic Questions

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

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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  

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  

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  

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?
0.194  
0.436  
2.29  
5.15  
Answer: B  

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  

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7) Which of the following represent isotopes?

A: $^{32}_{15}$  
B: $^{32}_{16}$  
C: $^{31}_{15}$  
D: $^{34}_{17}$

A and B  
A and C  
A and 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 $^{90}_{38}$Sr?

38 p, 52 n  
38 p, 90 n  
52 p, 38 n  
90 p, 38 n

Answer: A

Topic: Section 2.5 Atomic Numbers

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

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

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

1  
35  
36  
81

Answer: B

Topic: Section 2.5 Atomic Numbers
12) Identify the chemical symbol of element Q in $\text{34Q}$.

Br
Hg
Pd
Se
Answer: D
Topic: Section 2.5 Atomic Numbers

13) The number of nucleons in a $^{234}\text{Th}$ nucleus is
90.
144.
234.
324.
Answer: C
Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

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

A) $^{28}\text{Al}$
B) $^{31}\text{P}$.
C) $^{32}\text{Si}$.
D) $^{32}\text{S}$.
Answer: D
Topic: Section 2.8 Radioactivity

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

127
131
131
135
Answer: C
Topic: Section 2.8 Radioactivity

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

A) $^{16}\text{O}$
B) $^{14}\text{N}$
C) $^{15}\text{C}$
D) $^{13}\text{B}$
Answer: A
Topic: Section 2.9 Nuclear Stability
Which of the following nuclides is most likely to undergo beta decay?

190
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

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

176
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

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

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

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
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

In which set do all elements tend to form cations in binary ionic compounds?
K, Ga, O
Sr, Ni, Hg
N, P, Bi
O, Br, I
Answer: B
Topic: Section 2.11 Ions and Ionic Bonds

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

How many electrons are in the ion, P\(^{3-}\)?
A) 12
B) 18 C)
28 D) 34
Answer: B

In which of the following sets do all species have the same number of electrons? A)
F, Ne, Mg
Ge, Se, Br
K, Rb, Cs
Br, Br, Br
Answer: A
Topic: Section 2.11 Ions and Ionic Bonds

In which of the following sets do all species have the same number of protons? A)
F, Ne, Mg
Ge, Se, Br
K, Rb, Cs
Br, Br, Br
Answer: D
Topic: Section 2.11 Ions and Ionic Bonds
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

How many electrons are in the ion, $PO_4^{3-}$?
26
44
47
50
Answer: D

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

What type of bonding is found in the compound OF$_2$?
covalent bonding
hydrogen bonding
ionic bonding
metallic bonding
Answer: A

Which one of the following compounds contains ionic bonds?
A) SrO
B) H Br
C) P Br$_3$
D) SiO$_2$
Answer: A

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
Which of the compounds, Li$_3$N, NH$_3$, C$_3$H$_8$, IF$_3$ are ionic compounds?

A) only C$_3$H$_8$
B) only Li$_3$N

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

Which of the compounds CH$_4$, SrCl$_2$, Cr(NO$_3$)$_3$, XeF$_2$ are expected to exist as molecules?

A) only CH$_4$
B) CH$_4$ and XeF$_2$
C) CH$_4$, Cr(NO$_3$)$_2$, and XeF$_2$
D) SrCl$_2$ and Cr(NO$_3$)$_2$

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

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

The solid compound, Mg(NO$_3$)$_2$, contains Mg$^{2+}$, N$_5^+$, and O$^{2-}$ ions.

Answer: B

Topic: Section 2.11 Ions and Ionic Bonds

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

A) Fe$_3$S
B) Fe$_3$SO$_4$
C) Fe$_2$S$_3$
D) Fe$_2$(SO$_4$)$_3$

Answer: D

Topic: Section 2.12 Naming Chemical Compounds
39) What is the charge on the Cr ions in Cr\textsubscript{2}O\textsubscript{3}?
   \begin{itemize}
     \item 2-
     \item 1+
     \item 2+
     \item 3+
   \end{itemize}
   Answer: D
   Topic: Section 2.12 Naming Chemical Compounds

40) Rb\textsubscript{2}S is named
   \begin{itemize}
     \item rubidium disulfide.
     \item rubidium sulfide.
     \item rubidium(II) sulfide.
     \item rubidium sulfur.
   \end{itemize}
   Answer: B
   Topic: Section 2.12 Naming Chemical Compounds
   What is the chemical formula for calcium hydroxide?
   \begin{itemize}
     \item A) CaH\textsubscript{2}
     \item CaOH
     \item CaOH\textsubscript{2}
     \item Ca(OH)\textsubscript{2}
   \end{itemize}
   Answer: D
   Topic: Section 2.12 Naming Chemical Compounds
   What is the chemical formula for magnesium hydride?
   \begin{itemize}
     \item A) MgH\textsubscript{2}
     \item MgOH
     \item MgOH\textsubscript{2}
     \item Mg(OH)\textsubscript{2}
   \end{itemize}
   Answer: A
   Topic: Section 2.12 Naming Chemical Compounds

43) An aqueous solution of H\textsubscript{2}S is named
   \begin{itemize}
     \item hydrosulfuric acid.
     \item hydrosulfurous acid.
     \item sulfuric acid.
     \item sulfurous acid.
   \end{itemize}
   Answer: A
   Topic: Section 2.12 Naming Chemical Compounds

44) The chemical formula for the sulfite ion is
   \begin{itemize}
     \item S\textsuperscript{-}
     \item S\textsuperscript{2-}
     \item SO\textsubscript{3}\textsuperscript{2-}
     \item SO\textsubscript{4}\textsuperscript{2-}
   \end{itemize}
   Answer: C
   Topic: Section 2.12 Naming Chemical Compounds
The chemical formula for lithium peroxide is
A) LiOH.
B) \( \text{LiO}_2 \).
C) \( \text{Li}_2\text{O} \).

\( \text{Li}_2\text{O}_2 \)
Answer: D
Topic: Section 2.12 Naming Chemical Compounds

46) The compound, \( \text{Cu( I O}_3 \text{ )}_2 \), is named
copper iodate(II).
copper(I) iodate.
copper(I) iodate(II).
copper(II) iodate.
Answer: D
Topic: Section 2.12 Naming Chemical Compounds

47) The compound, \( \text{SO}_3 \), is named
sulfate.
sulfite.
sulfur trioxide.
sulfur (VI) oxide.
Answer: C
Topic: Section 2.12 Naming Chemical Compounds

48) The ion, \( \text{IO}_2^- \), is named
iodate ion.
iodite ion.
iodine dioxide ion.
iodine(II) oxide ion.
Answer: B
Topic: Section 2.12 Naming Chemical Compounds

The chemical formula for nitrous acid is
A) \( \text{H}_3\text{N(aq)} \).
B) \( \text{H NO}_2(aq) \).
C) \( \text{H NO}_3(aq) \).
D) \( \text{H}_2\text{N}_2\text{O}_6(aq) \).
Answer: B
Topic: Section 2.12 Naming Chemical Compounds
The chemical formula for calcium nitride is
A) Ca(NO3)2.
B) Ca(NO2)2.
C) Ca3N2. D) CaN2.
Answer: C

Topic: Section 2.12 Naming Chemical Compounds

2.3 Short Answer Questions

In the reaction HBr + NaOH → H2O + NaBr, If 81 g HBr react with 40 g of NaOH to produce 18 g of H2O, 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

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 CO2 is ________.
Answer: 6 g

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

The charge to mass ratio of an electron was determined from Rutherford’s cathode-ray tube experiment to be \(1.759 \times 10^{-19}\) C/g and the charge on a single electron was determined from the Millikan oil drop experiment to be \(1.602 \times 10^{-19}\) C, so the mass of a single electron is ________.
Answer: \(9.11 \times 10^{-28}\) g

Topic: Section 2.3 Atomic Structure: Electrons

The subatomic particles contained in the nucleus of an atom are ________ and ________.
Answer: protons, neutrons

Topic: Section 2.4 Atomic Structure: Protons and Neutrons

Atoms of the same element always have the same number of ________ in their nuclei.
Answer: protons

Topic: Section 2.5 Atomic Numbers

Isotopes have the same number of ________ but different numbers of ________ in their nuclei.
Answer: protons, neutrons

Topic: Section 2.5 Atomic Numbers

The symbol of the isotope having \(Z = 88\) and \(A = 226\) is ________.
Answer: \(^{226}_{88}\) Ra

Topic: Section 2.5 Atomic Numbers

The symbol for technetium-98 is ________.
Answer: \(^{98}_{43}\) Tc

Topic: Section 2.5 Atomic Numbers
The number of neutrons in a neutral atom of uranium-238 is ________.
Answer: 146
Topic: Section 2.5 Atomic Numbers

A neutral atom with atomic number 5 and mass number 11 contains ________ electrons.
Answer: 5
Topic: Section 2.5 Atomic Numbers

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

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

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

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

The number of protons, neutrons, and total nucleons in $^{106}_{44}$Ru are ________, ________, and ________, respectively.
Answer: 44, 62, 106
Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

The missing reactant in the nuclear reaction $^?_{?} \rightarrow ^{14}_{7}N + ^{0}_{1}e$ is ________.
Answer: $^{6}_{6}C$
Topic: Section 2.7 Nuclear Chemistry: The Change of One Element Into Another

In a nuclear reaction, the symbol for a beta particle is ________.
Answer: $^0_1e$ or $^\beta^-$
Topic: Section 2.8 Radioactivity

18) In a nuclear reaction $^2_{4}He$ is the symbol for ________.
Answer: an alpha particle
Topic: Section 2.8 Radioactivity
19) $^{238}\text{U}$ 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. $^{238}\text{U} \rightarrow ? + ?$

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

Topic: Section 2.8 Radioactivity

In an electron capture reaction a proton is converted into a ________.

Answer: neutron

Topic: Section 2.8 Radioactivity

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

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

The number of electrons in the ion $\text{Ca}^{2+}$ is ________.

Answer: 18

Topic: Section 2.11 Ions and Ionic Bonds

The number of electrons in the ion $\text{C}^{4–}$ is ________.

Answer: 10

Topic: Section 2.11 Ions and Ionic Bonds

The bonding in MgO is ________, whereas the bonding in CO is ________.

Answer: ionic, covalent

Topic: Section 2.11 Ions and Ionic Bonds

Phosphate ion has the formula ________.

Answer: $\text{PO}_4^{3–}$

Topic: Section 2.12 Naming Chemical Compounds

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

Answer: 2, 3

Topic: Section 2.12 Naming Chemical Compounds