

1 What is the angular momentum quantum number (l) value for the $3p$ sublevel?

A 1

CORRECT: For the $3p$ sublevel, the principal quantum number (n) is 3 and the angular momentum quantum number (l) is 1.

B 2

INCORRECT: This is the value of l for the $3d$ sublevel.

C 3

INCORRECT: For $n = 3$, the possible l values are 0, 1, and 2.

D 4

INCORRECT: For $n = 3$, the possible l values are 0, 1, and 2.

ICC Essential Concept:

Structure of Atoms

ICC Underlying Skill:

Atomic Structure

2 Which of the following is the conjugate base of H_2SO_4 ?

A OH^-

INCORRECT: OH^- is the conjugate base of H_2O .

B HSO_3^-

INCORRECT: HSO_3^- is the conjugate base of H_2SO_3 .

C HSO_4^-

CORRECT: A conjugate base is formed when an acid donates a proton. Because it has room to accept a proton, it is now called a base. When H_2SO_4 donates a proton, its conjugate base is HSO_4^- is formed.

D SO_4^{2-}

INCORRECT: SO_4^{2-} is the conjugate base of HSO_4^- .

ICC Essential Concept:

Chemical Reactions

ICC Underlying Skill:

Acids and Bases

3 Which of the following covalent single bonds is the most polar based on the electronegativity trends in the periodic table?

A C–F

CORRECT: The greater the electronegativity difference between the bonding atoms the more polar the bond. Electronegativity generally increases left to right across a period and decreases down a group in the periodic table. The C–F bond is the most polar.

B C–O

INCORRECT: Electronegativity generally increases left to right across a period and decreases down a group in the periodic table.

C C–N

INCORRECT: Electronegativity generally increases left to right across a period and decreases down a group in the periodic table.

D C–S

INCORRECT: Electronegativity generally increases left to right across a period and decreases down a group in the periodic table.

ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Periodic Properties

4 Which of the following covalent single bonds is the shortest based on the atomic radius trends in the periodic table?

A C–F

CORRECT: The smaller the atomic radii of the bonding atoms the shorter the bond. Atomic radius generally decreases left to right across a period and increases down a group in the periodic table. The C–F bond is the shortest.

B C–O

INCORRECT: Atomic radius generally decreases left to right across a period and increases down a group in the periodic table.

C C–N

INCORRECT: Atomic radius generally decreases left to right across a period and increases down a group in the periodic table.

D C–S

INCORRECT: Atomic radius generally decreases left to right across a period and increases down a group in the periodic table.

ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Periodic Properties

5 Which of the following molecules contains an odd total number of electrons?

A BeH_2

INCORRECT: The total number of electrons in a BeH_2 molecule is 6, 4 from the Be atom and 1 from each H atom.

B NO_2

CORRECT: The total number of electrons in a NO_2 molecule is 23, 7 from the N atom and 8 from each O atom.

C SF_6

INCORRECT: The total number of electrons in a SF_6 molecule is 70, 16 from the S atom and 9 from each F atom.

D PCl_3

INCORRECT: The total number of electrons in a PCl_3 molecule is 66, 15 from the P atom and 17 from each Cl atom.

ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Covalent Bonding

6 A scientist measured the freezing and boiling points of each of two water samples, a sea water sample and a pure water sample, at 1 atm. Which of the following did the scientist most likely observe? Compared to the pure water sample, the sea water sample had:

A the same freezing point and the same boiling point.

INCORRECT: Solutions, especially those of electrolytes, have a higher boiling point and a lower freezing point than does the pure solvent. Sea water is an aqueous electrolyte solution.

B a lower freezing point and a higher boiling point.

CORRECT: Solutions, especially those of electrolytes, have a higher boiling point and a lower freezing point than does the pure solvent. Sea water is an aqueous electrolyte solution.

C a lower freezing point and a lower boiling point.

INCORRECT: Solutions, especially those of electrolytes, have a higher boiling point and a lower freezing point than does the pure solvent. Sea water is an aqueous electrolyte solution.

D a higher freezing point and a lower boiling point.

INCORRECT: Solutions, especially those of electrolytes, have a higher boiling point and a lower freezing point than does the pure solvent. Sea water is an aqueous electrolyte solution.

ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Nature and Phases of Matter—Characteristics and Behavior

7 The percentage composition of ferric oxide, Fe_2O_3 , is closest to:

A 70% Fe and 30% O.

CORRECT: The formula mass of Fe_2O_3 is 159.7 amu of which 111.7 amu is contributed by Fe and 48.0 amu is contributed by O. Dividing 111.7 amu by 159.7 amu and then multiplying by 100% gives about 70%. Dividing 48.0 amu by 159.7 amu and then multiplying by 100% gives about 30%.

B 75% Fe and 25% O.

INCORRECT: Given the atomic masses of Fe and O and the formula of the compound, the percentage composition of Fe_2O_3 is closest to 70% Fe and 30% O.

C 80% Fe and 20% O.

INCORRECT: Given the atomic masses of Fe and O and the formula of the compound, the percentage composition of Fe_2O_3 is closest to 70% Fe and 30% O.

D 85% Fe and 15% O.

INCORRECT: Given the atomic masses of Fe and O and the formula of the compound, the percentage composition of Fe_2O_3 is closest to 70% Fe and 30% O.

ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Ionic Bonding

8 Which of the following is a common feature of all free radicals? They all:

A have an unpaired electron.

CORRECT: All free radicals, by definition, have one or more unpaired electrons. It is this characteristic that typically makes free radicals highly reactive.

B are neutral atoms.

INCORRECT: Free radicals can be molecular species and can have a positive or negative charge.

C are molecular species.

INCORRECT: Free radicals can be atomic species.

D are charged species.

INCORRECT: Free radicals can have a zero charge.

ICC Essential Concept:

Chemical Reactions

ICC Underlying Skill:

Common Reactions in Living Systems

9 What percent of a sample of a radioactive isotope will be left after two half-lives?

A 0.00%.

INCORRECT: After two half-lives, more than 0.00% of a sample of a radioactive isotope will be left.

B 12.5%

INCORRECT: After three half-lives, 12.5% of a sample of a radioactive isotope will be left.

C 25.0%

CORRECT: After two half-lives, 25.0% of a sample of a radioactive isotope will be left.

D 50.0%

INCORRECT: After one half-life, 50.0% of a sample of a radioactive isotope will be left.

ICC Essential Concept:

Structure of Atoms

ICC Underlying Skill:

Isotopes

10 A positive entropy change (ΔS) is associated with which, if either, of the phase-change processes melting and condensation?

A Melting only

CORRECT: When a substance melts, it changes from a solid to a liquid and disorder increases. This results in a positive entropy change (ΔS).

B Condensation only

INCORRECT: When a substance condenses, it changes from a gas to a liquid and disorder decreases. This results in a negative entropy change (ΔS).

C Melting as well as condensation

INCORRECT: A positive entropy change (ΔS) is associated with melting but not with condensation.

D Neither melting nor condensation

INCORRECT: A positive entropy change (ΔS) is associated with melting.

ICC Essential Concept:

Conservation of Energy and Increase in Disorder

ICC Underlying Skill:

Conservation of Energy

11 Consider the chemical reaction



Which of the following is equal to the mass of KClO_3 that is needed to produce 32.0 g of O_2 ?

A 40.8 g

INCORRECT: The mass of KClO_3 needed to produce 32.0 g of O_2 is 81.7 g given that the molar mass of O_2 is 32.0 g/mol, the molar mass of KClO_3 is 122.5 g/mol, and the mole ratio is 2 mol of KClO_3 to 3 mol of O_2 .

B 81.7 g

CORRECT: The mass of KClO_3 needed to produce 32.0 g of O_2 is 81.7 g given that the molar mass of O_2 is 32.0 g/mol, the molar mass of KClO_3 is 122.5 g/mol, and the mole ratio is 2 mol of KClO_3 to 3 mol of O_2 .

C 244 g

INCORRECT: The mass of KClO_3 needed to produce 32.0 g of O_2 is 81.7 g given that the molar mass of O_2 is 32.0 g/mol, the molar mass of KClO_3 is 122.5 g/mol, and the mole ratio is 2 mol of KClO_3 to 3 mol of O_2 .

D 734 g

INCORRECT: The mass of KClO_3 needed to produce 32.0 g of O_2 is 81.7 g given that the molar mass of O_2 is 32.0 g/mol, the molar mass of KClO_3 is 122.5 g/mol, and the mole ratio is 2 mol of KClO_3 to 3 mol of O_2 .

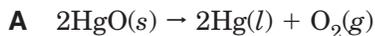
ICC Essential Concept:

Chemical Reactions

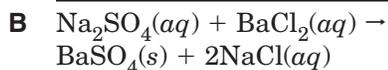
ICC Underlying Skill:

Conservation of Matter

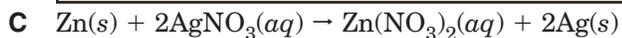
12 Which of the following chemical reactions is best classified as an acid–base reaction?



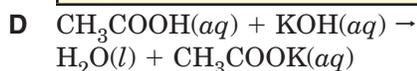
INCORRECT: The breakdown of mercury(II) oxide into mercury metal and oxygen is a decomposition reaction.



INCORRECT: The precipitation reaction between sodium sulfate and barium chloride to form barium sulfate and sodium chloride is a double-displacement reaction..



INCORRECT: The redox reaction between zinc metal and silver nitrate to form zinc nitrate and silver metal is a single-displacement reaction.



CORRECT: Acetic acid and potassium hydroxide react to form water and potassium acetate in this acid–base neutralization reaction.

ICC Essential Concept:

Chemical Reactions

ICC Underlying Skill:

Acids and Bases

13 The specific heat capacity (commonly known as specific heat) of copper is $0.0925 \text{ cal}/(\text{g}\cdot^\circ\text{C})$. If a 15.0-g sample of copper is heated from 20.0°C to 350.0°C , the heat absorbed by the sample will be equal to which of the following?

A $330. \text{ cal}$

INCORRECT: ΔT is 330.0°C , q will not be $330. \text{ cal}$.

B 458 cal

CORRECT: Given the equation $q = mc\Delta T$, where m is 15.0 g , c is $0.0925 \text{ cal}/(\text{g}\cdot^\circ\text{C})$, and ΔT is 330.0°C , q will be 458 cal .

C $4.95 \times 10^3 \text{ cal}$

INCORRECT: Multiplying 15.0 g by 330.0°C gives $4.95 \times 10^3 \text{ g}\cdot^\circ\text{C}$.

D $5.35 \times 10^4 \text{ cal}$

INCORRECT: Multiplying 15.0 g by 330.0°C and then dividing by $0.0925 \text{ cal}/(\text{g}\cdot^\circ\text{C})$ gives $5.35 \times 10^4 \text{ g}^2\cdot^\circ\text{C}^2/\text{cal}$.

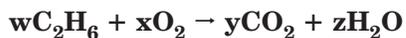
ICC Essential Concept:

Structure and Properties of Matter

ICC Underlying Skill:

Factors Affecting Atomic Interactions

- 14** Consider the chemical equation shown in which the lowercase letters represent the coefficients of the reactants and products.



When the equation is correctly balanced, what will be the sum of these coefficients ($w + x + y + z$)?

A 4

INCORRECT: When the equation is balanced correctly, $w = 2$, $x = 7$, $y = 4$, and $z = 6$. Thus, $w + x + y + z$ will be equal to 19.

B 13

INCORRECT: When the equation is balanced correctly, $w = 2$, $x = 7$, $y = 4$, and $z = 6$. Thus, $w + x + y + z$ will be equal to 19.

C 17

INCORRECT: When the equation is balanced correctly, $w = 2$, $x = 7$, $y = 4$, and $z = 6$. Thus, $w + x + y + z$ will be equal to 19.

D 19

CORRECT: When the equation is balanced correctly, $w = 2$, $x = 7$, $y = 4$, and $z = 6$. Thus, $w + x + y + z$ will be equal to 19.

ICC Essential Concept:

Chemical Reactions

ICC Underlying Skill:

Conservation of Matter

15 An atom of an isotope contains 81 protons, 81 electrons, and 124 neutrons. What is the mass number of the isotope?

A 124

INCORRECT: The number of neutrons is 124.

B 162

INCORRECT: The sum of the number of protons and the number of electrons is 162.

C 205

CORRECT: The mass number is equal to the sum of the number of protons and the number of neutrons. The mass number is 205.

D 286

INCORRECT: The sum of the number of protons, the number of electrons, and the number of neutrons is 286.

ICC Essential Concept:

Structure of Atoms

ICC Underlying Skill:

Isotopes