# AMERICAN CHEMICAL SOCIETY (ACS) CHEMISTRY PRACTICE EXAM (SAMPLE)

## STUDY GUIDE


## SAMPLE STUDY GUIDE WITH LIMITED QUESTIONS

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https://acs-chemistry.examzify.com

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# Introduction

Preparing for a certification exam can feel overwhelming, but with the right tools, it becomes an opportunity to build confidence, sharpen your skills, and move one step closer to your goals. At Examzify, we believe that effective exam preparation isn't just about memorization, it's about understanding the material, identifying knowledge gaps, and building the test-taking strategies that lead to success.

This guide was designed to help you do exactly that.

Whether you're preparing for a licensing exam, professional certification, or entry-level qualification, this book offers structured practice to reinforce key concepts. You'll find a wide range of multiple-choice questions, each followed by clear explanations to help you understand not just the right answer, but why it's correct.

The content in this guide is based on real-world exam objectives and aligned with the types of questions and topics commonly found on official tests. It's ideal for learners who want to:

- Practice answering questions under realistic conditions,
- Improve accuracy and speed,
- Review explanations to strengthen weak areas, and
- Approach the exam with greater confidence.

We recommend using this book not as a stand-alone study tool, but alongside other resources like flashcards, textbooks, or hands-on training. For best results, we recommend working through each question, reflecting on the explanation provided, and revisiting the topics that challenge you most.

Remember: successful test preparation isn't about getting every question right the first time, it's about learning from your mistakes and improving over time. Stay focused, trust the process, and know that every page you turn brings you closer to success.

Let's begin.

# How to Use This Guide

This guide is designed to help you study more effectively and approach your exam with confidence. Whether you're reviewing for the first time or doing a final refresh, here's how to get the most out of your Examzify study guide:

### 1. Start with a Diagnostic Review

Skim through the questions to get a sense of what you know and what you need to focus on. Your goal is to identify knowledge gaps early.

### 2. Study in Short, Focused Sessions

Break your study time into manageable blocks (e.g. 30 – 45 minutes). Review a handful of questions, reflect on the explanations.

### 3. Learn from the Explanations

After answering a question, always read the explanation, even if you got it right. It reinforces key points, corrects misunderstandings, and teaches subtle distinctions between similar answers.

### 4. Track Your Progress

Use bookmarks or notes (if reading digitally) to mark difficult questions. Revisit these regularly and track improvements over time.

### 5. Simulate the Real Exam

Once you're comfortable, try taking a full set of questions without pausing. Set a timer and simulate test-day conditions to build confidence and time management skills.

### 6. Repeat and Review

Don't just study once, repetition builds retention. Re-attempt questions after a few days and revisit explanations to reinforce learning. Pair this guide with other Examzify tools like flashcards, and digital practice tests to strengthen your preparation across formats.

There's no single right way to study, but consistent, thoughtful effort always wins. Use this guide flexibly, adapt the tips above to fit your pace and learning style. You've got this!

# Questions

**1. Which of the following compounds is soluble with phosphate?**

A. Calcium phosphate

B. Potassium phosphate

C. Sodium phosphate

D. Iron phosphate

**2. What is the equation for calculating Gibbs free energy?**

A. $\Delta G = \Delta H + T\Delta S$

B. $\Delta G = \Delta H - T\Delta S$

C. $\Delta G = \Delta H * T\Delta S$

D. $\Delta G = \Delta H / T\Delta S$

**3. Which ion type is larger?**

A. Anions

B. Cations

C. Neutral atoms

D. All ions are the same size

**4. What type of radiation is uncharged?**

A. α-particles

B. β-particles

C. γ-rays

D. All of the above

**5. What is the shape of a dx2-y2 orbital?**

A. It has four lobes oriented along the x and y axes

B. It is spherical in nature

C. It is a dumbbell shape

D. It has a single lobe

**6. For a molecule with 6 electron domains where there is 1 nonbonding pair, what is the electron domain geometry?**

A. Trigonally planar

B. Octahedral

C. Tetrahedral

D. Trigonal bipyramidal

**7. How did Rutherford discover the proton?**

A. By observing β-particles

B. By bombarding N2 with α-particles

C. By using X-ray spectroscopy

D. By measuring atomic weights

**8. Which of the following descriptions matches the electron domain geometry of a molecule with 4 electron domains and no nonbonding pairs?**

A. Trigonal planar

B. Tetrahedral

C. Octahedral

D. Linear

**9. Which of the following is a characteristic of ionic compounds?**

A. They have high melting points

B. They conduct electricity in solid form

C. They are typically gaseous at room temperature

D. They have low solubility in water

**10. If the concentration of a reactant in an equilibrium reaction is decreased, what is the expected effect on the equilibrium position?**

A. Shift to the right

B. Shift to the left

C. No effect on the position

D. The reaction will stop

# Answers

1. B
2. B
3. A
4. C
5. A
6. B
7. B
8. B
9. A
10. B

# Explanations

## 1. Which of the following compounds is soluble with phosphate?

A. Calcium phosphate

B. Potassium phosphate

C. Sodium phosphate

D. Iron phosphate

*The solubility of a compound with phosphate ions varies based on the cation it is paired with. Potassium phosphate, which contains potassium as the cation, tends to be soluble in water. This is largely due to the general rule that salts of alkali metals, like potassium, are soluble in water. In contrast, compounds like calcium phosphate and iron phosphate tend to form precipitates in aqueous solutions due to their lower solubility. Calcium phosphate is known to have low solubility because of the common ion effect and the relatively small solubility product constant (Ksp) associated with it. Similarly, iron phosphate is also insoluble in water under most conditions. Thus, when evaluating the solubility of various phosphates, potassium phosphate stands out as the soluble option in the presence of phosphate ions.*

## 2. What is the equation for calculating Gibbs free energy?

A. $\Delta G = \Delta H + T\Delta S$

B. $\Delta G = \Delta H - T\Delta S$

C. $\Delta G = \Delta H * T\Delta S$

D. $\Delta G = \Delta H / T\Delta S$

*The equation for calculating Gibbs free energy is represented as $\Delta G = \Delta H - T\Delta S$. This relationship is fundamental in thermodynamics and determines the spontaneity of a process at constant temperature and pressure. In this equation: - $\Delta G$ represents the change in Gibbs free energy. - $\Delta H$ refers to the change in enthalpy (heat content) of the system. - T is the absolute temperature measured in Kelvin. - $\Delta S$ is the change in entropy, which quantifies the disorder or randomness of a system. The equation illustrates that the change in Gibbs free energy is influenced by the balance between the enthalpy change and the entropy change of a system, adjusted for temperature. A negative value of $\Delta G$ indicates that a reaction is spontaneous, while a positive value suggests that the reaction is non-spontaneous under the specified conditions. Choosing the correct sign for the equation is crucial; the subtraction of the product of temperature and entropy from the enthalpy change allows us to account for the energy that is dispersed or spread out as a system moves toward equilibrium. Thus, this formulation helps chemists predict whether a reaction will proceed forward under given conditions.*

## 3. Which ion type is larger?

A. Anions

B. Cations

C. Neutral atoms

D. All ions are the same size

*Anions are larger than cations due to the differences in their electronic structures and the effects of nuclear charge. Anions, which are negatively charged, gain one or more electrons. This addition of electrons increases electron-electron repulsion within the electron cloud, leading to a greater distance between the electrons and, consequently, an increase in the size of the electron cloud. On the other hand, cations are positively charged and lose one or more electrons. The loss of electrons results in reduced electron-electron repulsion and a tighter pull on the remaining electrons by the nucleus, often leading to a smaller ionic radius compared to the neutral atom from which they came. Neutral atoms fall between anions and cations in size. They typically have a balanced number of protons and electrons, resulting in a specific radius that is smaller than that of anions but larger than that of cations. All ions are certainly not the same size, as their radii depend significantly on their charge and the number of electrons present, making it clear why anions are generally larger than both cations and neutral atoms.*

## 4. What type of radiation is uncharged?

A. α-particles

B. β-particles

C. γ-rays

D. All of the above

*Gamma rays are a form of electromagnetic radiation that is uncharged and has no mass. This differentiates them from alpha and beta particles. Alpha particles are helium nuclei, consisting of two protons and two neutrons, making them positively charged. Beta particles, which are high-energy, high-speed electrons (or positrons), carry a negative or positive charge, respectively. In contrast, gamma rays do not possess any charge or mass, which allows them to penetrate materials more easily compared to the other forms of radiation. This characteristic makes gamma radiation particularly significant in various applications such as medical imaging and cancer treatment, where uncharged radiation can traverse tissues without being significantly deflected or absorbed.*

## 5. What is the shape of a dx2-y2 orbital?

A. It has four lobes oriented along the x and y axes

B. It is spherical in nature

C. It is a dumbbell shape

D. It has a single lobe

*The dx2-y2 orbital has a distinctive shape characterized by having four lobes that extend along the x and y axes. This orientation allows for the lobes to be positioned in the directions between the two axes, effectively creating a configuration that resembles a cloverleaf. The presence of four lobes indicates that this orbital is specifically designed to hold electrons in a manner that maximizes their distance from the nucleus while aligning with the geometrical axes of the coordinate system. In contrast, the other shapes mentioned in the options do not reflect the characteristics of the dx2-y2 orbital. A spherical shape would correspond to the s orbitals, which are uniform in all directions. A dumbbell shape is typical of p orbitals, which contain two distinct lobes but do not have the four-lobed characteristic of the dx2-y2 orbital. Lastly, a single lobe pertains to an orbital like the s orbital, which is singular and lacks the complexity of d orbitals. Therefore, the identification of the dx2-y2 orbital as having four lobes oriented along the x and y axes captures its unique geometric and energetic properties accurately.*

## 6. For a molecule with 6 electron domains where there is 1 nonbonding pair, what is the electron domain geometry?

A. Trigonally planar

B. Octahedral

C. Tetrahedral

D. Trigonal bipyramidal

*In a molecule with 6 electron domains, the arrangement of these domains is based on the principles of VSEPR (Valence Shell Electron Pair Repulsion) theory, which states that electron pairs arrange themselves to minimize repulsive forces. When one of these domains is a nonbonding pair (also known as a lone pair), it affects the overall geometry. For a total of 6 electron domains, the ideal arrangement is octahedral, which has bond angles of 90 degrees between adjacent positions. In this scenario, even though one of the domains is a lone pair, the presence of the other 5 bonded atoms leads to the determination that the electron domain geometry remains octahedral. The lone pair will take up one position in the octahedral coordination, leading to a molecular geometry that might differ (like square pyramidal or square planar), but the arrangement of the electron domains as a whole is still classified as octahedral. Thus, the correct identification of the electron domain geometry is octahedral.*

## 7. How did Rutherford discover the proton?

A. By observing β-particles

B. By bombarding N2 with α-particles

C. By using X-ray spectroscopy

D. By measuring atomic weights

*Rutherford's discovery of the proton was a pivotal moment in the understanding of atomic structure. The correct answer involves his experiments where he bombarded nitrogen gas (\(N_2\)) with alpha particles (\(α\)-particles). During these experiments, Rutherford found that when the alpha particles interacted with the nitrogen nuclei, some of them resulted in the emission of hydrogen nuclei, which are now recognized as protons. The significance of this experiment lies in the fact that the emission of protons indicated the existence of these positively charged particles within the nucleus, leading to the realization that the nucleus contains protons and is indeed central to atomic structure. This experiment effectively demonstrated that nitrogen nuclei had been transformed into hydrogen nuclei, confirming the idea of a positively charged proton as a fundamental particle of the atom. Other choices do not align with Rutherford's findings regarding the proton. Observing beta particles concerns a different type of nuclear decay and does not relate to the identification of protons. X-ray spectroscopy was used for probing electronic structures rather than nuclear constituents. Measuring atomic weights pertains to the determination of atomic masses without directly indicating the presence of protons. Thus, the bombardment of nitrogen with alpha particles directly contributed to the identification and understanding of protons in atomic theory.*

## 8. Which of the following descriptions matches the electron domain geometry of a molecule with 4 electron domains and no nonbonding pairs?

A. Trigonal planar

B. Tetrahedral

C. Octahedral

D. Linear

*For a molecule with four electron domains and no nonbonding pairs, the correct electron domain geometry is tetrahedral. This geometry arises when there are four areas of electron density surrounding a central atom, which can include bonds to other atoms or lone pairs of electrons. In the case of four electron domains, these domains arrange themselves around the central atom to minimize repulsion, a principle known as VSEPR (Valence Shell Electron Pair Repulsion) theory. In a tetrahedral arrangement, the four bonding pairs orient themselves toward the corners of a tetrahedron, achieving maximum separation of about 109.5 degrees between them. This configuration allows the molecule to be stable and minimizes electron pair repulsion, which is why tetrahedral is the expected geometry for such a molecular setup. The other options correspond to different electron domain geometries: trigonal planar applies to three electron domains, octahedral relates to six, and linear describes two domains. Therefore, it is the presence of four electron domains that specifically defines the tetrahedral geometry in this instance.*

**9. Which of the following is a characteristic of ionic compounds?**

A. They have high melting points

B. They conduct electricity in solid form

C. They are typically gaseous at room temperature

D. They have low solubility in water

*Ionic compounds are known for their high melting points, which can be attributed to the strong electrostatic forces of attraction between the positively charged cations and negatively charged anions. These ionic bonds require a significant amount of energy to break, resulting in a high temperature being necessary to melt these substances. For instance, common ionic compounds such as sodium chloride (table salt) have melting points that are much higher than those of molecular compounds. In contrast, the other options are not characteristics of ionic compounds. Ionic compounds typically do not conduct electricity in their solid state because the ions are fixed in place within the crystal lattice structure and cannot move freely. They do, however, conduct electricity when melted or dissolved in water, as the ions are then free to move. Additionally, ionic compounds are generally solid at room temperature, not gaseous. Lastly, ionic compounds are usually soluble in water due to their ability to dissociate into their constituent ions and interact favorably with water molecules, contrary to the idea of low solubility in water.*

**10. If the concentration of a reactant in an equilibrium reaction is decreased, what is the expected effect on the equilibrium position?**

A. Shift to the right

B. Shift to the left

C. No effect on the position

D. The reaction will stop

*When the concentration of a reactant in an equilibrium reaction is decreased, the system responds according to Le Chatelier's principle. This principle states that if a dynamic equilibrium is disturbed by changing the conditions, the position of equilibrium will shift to counteract the change and restore balance. In this case, reducing the concentration of a reactant causes the equilibrium to shift toward the side of the reaction that produces more of that reactant. This shift occurs because the system tries to increase the concentration of the reactant that has been reduced, hence the equilibrium position will move to the left, favoring the formation of reactants from products. This principle emphasizes the dynamic nature of chemical equilibria and highlights how systems seek to maintain equilibrium despite changes in concentration, temperature, or pressure.*

# Next Steps

Congratulations on reaching the final section of this guide. You've taken a meaningful step toward passing your certification exam and advancing your career.

As you continue preparing, remember that consistent practice, review, and self-reflection are key to success. Make time to revisit difficult topics, simulate exam conditions, and track your progress along the way.

If you need help, have suggestions, or want to share feedback, we'd love to hear from you. Reach out to our team at hello@examzify.com.

Or visit your dedicated course page for more study tools and resources:

https://acs-chemistry.examzify.com

We wish you the very best on your exam journey. You've got this!