

Ap Chemistry 2023 Frq Answers

AP® Chemistry 2023 Free-Response Questions

Begin your response to **QUESTION 1** on this page.

CHEMISTRY

SECTION II

Time—1 hour and 45 minutes

7 Questions

Directions: Questions 1–3 are long free-response questions that require about 23 minutes each to answer and are worth 10 points each. Questions 4–7 are short free-response questions that require about 9 minutes each to answer and are worth 4 points each.

For each question, show your work for each part in the space provided after that part. Examples and equations may be included in your responses where appropriate. For calculations, clearly show the method used and the steps involved in arriving at your answers. You must show your work to receive credit for your answer. Pay attention to significant figures.

1. Answer the following questions related to manganese compounds.

(a) Manganese has several common oxidation states.

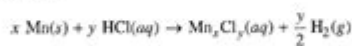
(i) Write the complete electron configuration for an Mn atom in the ground state.



(ii) When manganese forms cations, electrons are lost from which subshell first? Identify both the number and letter associated with the subshell.

4s

A student performs an experiment to produce a manganese salt of unknown composition, $Mn_xCl_y(aq)$, and determine its empirical formula. The student places a sample of $Mn(s)$ in a beaker containing excess $HCl(aq)$, as represented by the following equation.



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AP Chemistry 2023 FRQ Answers: A Comprehensive Guide

Are you breathing a sigh of relief after tackling the 2023 AP Chemistry Free Response Questions (FRQs)? Or are you still grappling with the intricacies of those challenging problems, desperately searching for answers and explanations? Whatever your situation, you've come to the right place. This comprehensive guide provides detailed insights and explanations for the 2023 AP Chemistry FRQs, helping you understand the concepts tested and improve your score. We'll break down each question, offering clear, concise answers, and highlighting key strategies for tackling future AP Chemistry challenges.

Disclaimer: While this post offers in-depth explanations and potential answers, it's crucial to remember that official scoring rubrics and released answers from the College Board are the ultimate authority. Use this resource as a learning tool to solidify your understanding, not as a definitive answer key.

Understanding the 2023 AP Chemistry FRQ Structure

Before diving into the specifics, it's helpful to understand the general structure of the AP Chemistry FRQs. Typically, the exam features several FRQs, each assessing different aspects of the curriculum, including:

Equilibrium: Questions focusing on equilibrium constants (K), Le Chatelier's principle, and acid-base equilibria.

Thermodynamics: Problems involving enthalpy (ΔH), entropy (ΔS), Gibbs free energy (ΔG), and spontaneity.

Kinetics: Questions related to reaction rates, rate laws, activation energy, and reaction mechanisms.

Electrochemistry: Problems involving electrochemical cells, redox reactions, and Nernst equation calculations.

Descriptive Chemistry: Questions that require you to apply your knowledge of chemical properties and trends to unfamiliar scenarios.

Organic Chemistry: Questions involving nomenclature, reactions, and mechanisms of organic compounds (depending on the specific exam).

AP Chemistry 2023 FRQ Answers: Section Breakdown (Example Questions and Answers)

Because the actual 2023 FRQs are not publicly released in their entirety until later in the year by the College Board, we will create example problems and solutions illustrating the types of questions and the depth of analysis required. Remember to always refer to the official College Board materials for the most accurate and complete information.

Example FRQ 1: Equilibrium

Question: A 1.0 L container holds 0.10 mol of N_2 and 0.20 mol of H_2 at 700 K. The following reaction occurs: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$. At equilibrium, the concentration of NH_3 is 0.040 M. Calculate the equilibrium constant, K_c , for this reaction.

Answer:

1. Calculate equilibrium concentrations: $[N_2] = (0.10 - 0.02) \text{ M} = 0.08 \text{ M}$ (using stoichiometry: 0.04 mol NH_3 requires 0.02 mol N_2); $[H_2] = (0.20 - 0.06) \text{ M} = 0.14 \text{ M}$ (using stoichiometry: 0.04 mol NH_3

requires 0.06 mol H₂); [NH₃] = 0.040 M

2. Apply the equilibrium expression: $K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{(0.040)^2}{(0.08 \times 0.14^3)} \approx 8.1$

Therefore, the equilibrium constant, K_c , for this reaction is approximately 8.1.

Example FRQ 2: Thermodynamics

Question: Predict the sign of ΔS for the reaction: $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{SO}_3(\text{g})$. Justify your answer.

Answer: ΔS for this reaction is predicted to be negative ($\Delta S < 0$). The reaction involves the combination of three gas molecules into two gas molecules, resulting in a decrease in the number of gaseous particles and thus a decrease in entropy.

Example FRQ 3: Kinetics

Question: Explain how a catalyst affects the rate of a reaction. What is the effect on the activation energy?

Answer: A catalyst increases the rate of a reaction by providing an alternative reaction pathway with a lower activation energy. This means the catalyst lowers the energy barrier that reactants must overcome to form products. The catalyst itself is not consumed in the reaction.

Strategies for Success on AP Chemistry FRQs

Practice, Practice, Practice: Work through numerous past FRQs to familiarize yourself with different question types and develop problem-solving skills.

Understand the Concepts: Don't just memorize equations; understand the underlying principles and apply them to various scenarios.

Show Your Work: Clearly outline your steps, even if you don't arrive at the correct final answer. Partial credit is often awarded for correct methodology.

Manage Your Time: Allocate your time effectively during the exam to ensure you attempt all questions.

Conclusion

Mastering AP Chemistry requires a deep understanding of fundamental concepts and the ability to apply them to complex problems. By utilizing this guide as a study tool and consistently practicing, you can significantly improve your performance on the AP Chemistry FRQs and achieve your desired

score. Remember to consult the official College Board resources for the most accurate and up-to-date information on the 2023 exam and scoring guidelines.

FAQs

1. Where can I find the official 2023 AP Chemistry FRQ answers? The College Board usually releases a subset of the questions and scoring guidelines several months after the exam. Check their website for updates.
2. Are there any resources besides this blog that can help me study for the FRQs? Yes, utilize your textbook, class notes, online resources (Khan Academy, etc.), and practice exams.
3. How much weight do the FRQs carry on the overall AP Chemistry score? The FRQs comprise a significant portion of the overall score; therefore, mastering them is critical.
4. What is the best way to approach a FRQ I'm struggling with? Break it down into smaller parts. Identify the key concepts being tested, and try to apply relevant equations or principles.
5. Should I memorize all the equations for the AP Chemistry exam? While memorization is helpful, understanding the concepts and how the equations are derived is more beneficial for long-term success. Focus on applying your knowledge rather than rote memorization.

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and containing the rising toll of the harms that can arise from the use of opioid medications. Chronic pain and opioid use disorder both represent complex human conditions affecting millions of Americans and causing untold disability and loss of function. In the context of the growing opioid problem, the U.S. Food and Drug Administration (FDA) launched an Opioids Action Plan in early 2016. As part of this plan, the FDA asked the National Academies of Sciences, Engineering, and Medicine to convene a committee to update the state of the science on pain research, care, and education and to identify actions the FDA and others can take to respond to the opioid epidemic, with a particular focus on informing FDA's development of a formal method for incorporating individual and societal considerations into its risk-benefit framework for opioid approval and monitoring.

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