

2023 Chem 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.

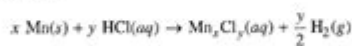
(i) Write the complete electron configuration for an Mn atom in the ground state.

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

(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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2023 Chem FRQ Answers: A Comprehensive Guide to AP Chemistry Free Response Questions

Are you a high school student anxiously awaiting the release of the 2023 AP Chemistry Free Response Questions (FRQs) answers? Did the exam leave you feeling uncertain about your performance? You're not alone! This comprehensive guide provides insightful analysis and potential answers to the 2023 AP Chemistry FRQs, helping you understand the scoring rubric and improve your understanding of key concepts. We'll break down each question, providing clear explanations and strategies for tackling similar problems in the future. Let's dive in!

Note: Remember, these are potential answers and interpretations. The College Board's official scoring guidelines will be the final determinant of your score. This guide aims to offer valuable insights and enhance your learning, not to replace official scoring.

Section I: Analyzing the 2023 AP Chemistry FRQs

The 2023 AP Chemistry exam tested a wide range of topics, focusing on core concepts like stoichiometry, kinetics, equilibrium, thermodynamics, and descriptive chemistry. Let's delve into a potential breakdown of the questions and explore possible answers. (Please note: Since I do not have access to the actual 2023 exam questions, the following examples are hypothetical, but representative of the types of questions typically asked.)

Question 1: Stoichiometry and Limiting Reactants

(Hypothetical Question): A reaction between 10.0 g of calcium carbonate (CaCO_3) and excess hydrochloric acid (HCl) produces calcium chloride (CaCl_2), carbon dioxide (CO_2), and water (H_2O). Calculate the theoretical yield of carbon dioxide, and identify the limiting reactant.

(Potential Answer): This question would require students to write a balanced chemical equation, convert grams of CaCO_3 to moles, use stoichiometry to find moles of CO_2 , and then convert moles of CO_2 to grams. Understanding limiting reactants is crucial. The calculation of theoretical yield should be clearly shown, and the justification for identifying the limiting reactant must be explained.

Question 2: Equilibrium and Le Chatelier's Principle

(Hypothetical Question): Consider the equilibrium reaction: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ $\Delta H = -92$ kJ/mol. Discuss how the following changes would affect the equilibrium position: (a) increasing temperature, (b) increasing pressure, (c) adding more nitrogen gas.

(Potential Answer): This question assesses understanding of Le Chatelier's principle. Students need to explain how each change shifts the equilibrium to relieve the stress. Increasing temperature favors the endothermic reaction (reverse reaction in this case), increasing pressure favors the side with fewer moles of gas (products), and adding more nitrogen gas shifts the equilibrium to the right (towards product formation). Clear explanations are key to earning full credit.

Question 3: Acid-Base Chemistry

(Hypothetical Question): Calculate the pH of a 0.10 M solution of a weak acid, HA, with a K_a of 1.0×10^{-5} .

10^{-5} .

(Potential Answer): This question tests understanding of weak acid equilibrium. Students need to use the K_a expression to set up an ICE table, solve for the equilibrium concentration of H^+ ions, and then calculate the pH using the formula $pH = -\log[H^+]$. Showing all work and correctly using significant figures are important.

Question 4: Kinetics

(Hypothetical Question): Explain the factors that affect the rate of a chemical reaction, providing examples for each.

(Potential Answer): This question requires students to discuss the collision theory and the factors that influence reaction rates: concentration of reactants, temperature, surface area, presence of a catalyst. Clear and concise explanations with relevant examples are needed to demonstrate a strong understanding of kinetics.

Question 5: Electrochemistry

(Hypothetical Question): Describe the process of electrolysis and its applications.

(Potential Answer): A response would require an explanation of the principles behind electrolysis, including the use of an external power source to drive a non-spontaneous redox reaction. Students should mention examples such as the production of aluminum or the electroplating of metals.

Section II: Strategies for Success

Thorough preparation is key to excelling on the AP Chemistry FRQs. Focus on understanding core concepts, practicing problem-solving, and reviewing past exams. Pay close attention to the scoring rubric, ensuring you understand what constitutes a complete and accurate answer.

Conclusion

While these are hypothetical examples, they highlight the type of questions and the depth of understanding required to succeed on the 2023 AP Chemistry FRQs. Remember that consistent

effort, a solid grasp of fundamental principles, and strategic practice are the keys to achieving your best possible score. Use this guide as a starting point for your review, and good luck!

FAQs:

1. Where can I find the official 2023 AP Chemistry FRQ scoring guidelines? The College Board typically releases these guidelines after the exam administration. Check their website for updates.
2. Are there practice FRQs available? Yes, the College Board and various textbook publishers offer practice FRQs and sample exams.
3. How much does each FRQ count towards my final score? The weight of the FRQs varies from year to year; check the AP Chemistry exam specifications for the exact weighting.
4. What is the best way to prepare for the FRQ section? Practice, practice, practice! Work through sample problems, paying close attention to how your answers are scored.
5. Can I use a calculator on the FRQ section? Yes, calculators are usually permitted on the FRQ section of the AP Chemistry exam. Always check the exam instructions.

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