## AP Chemistry Exam Reader Tips

#### Familiarize students with the format

It is important students understand the format of the exam to allow for proper expectations and to plan their time most effectively. Here are some details that may help them know what to expect.

* The AP Chemistry exam consists of 60 multiple-choice questions, 10 of which are “field-testing.” The field-testing questions will not be counted towards students’ final grades, but they will have no way of knowing which questions are which.
* The questions are bound in a book with a reference table, and students will have to turn back and forth between the questions and the reference table.
* Students may write notes and “scratch work” anywhere on the exam, but are required to answer the questions on the provided answer sheet within 90 minutes. Exam readers never see these handwritten notes.
* Students are generally given a short break between the multiple-choice and free-response sections (the length of time for this break depends on the school). After the break, the students receive all-new exam packets and bound books containing fresh reference tables.
* The free-response section consists of three long questions, each requiring an average of 23 minutes and worth up to ten points each.
* There are also four short questions requiring an average of nine minutes, worth up to four points each.
* Each free-response question is printed on one-to-two pages with no space for work (we will get back to this later). Following the question, multiple pages of paper are provided in the bound book for the responses.

It is important for students to understand the exam format beforehand so they can plan how to organize their time and work. I recommend giving the students a practice exam, so they have experience with the set-up. You may choose to give an old exam; but be aware the students have access to the answers online. If you completed the [AP Audit](https://apcentral.collegeboard.org/courses/ap-course-audit), you have access to multiple practice exams. These practice exams are secure, meaning that they should not be posted on any websites or available for students to access at home. Therefore, it is important for AP Chemistry teachers to be sure to keep the tests in class only so other teachers can use it as an authentic assessment tool.

My students took all of the practice exams at some point in the school year and, when I asked them which they found most valuable for reviewing, the majority of students mentioned these practice exams. Using these exams, the students were able to practice time management and actually see the format of the exam prior to exam day.

#### **Organizing free-response answers properly**

Readers must read all the pages of work surrounding and following the question they are grading. So if the student writes some answers next to the questions and others on the extra pages, we grade it all. Consequently, serious problems can arise when students are unfamiliar with the exam format and what is expected of them.

As mentioned previously, the free-response questions are printed with very little room for students to work out their answers in the space provided immediately below the question in the exam booklet. Instead, they are supposed to show their work and answers in the spaces provided after each question in the answer booklet.

I understand that it can be difficult for students to continuously turn the pages back and forth in order to see the question and then write their answers. But it is definitely better than trying to write in the tiny spaces between the questions. Too often, students write so small that it is nearly impossible to read their response. What’s more, students who write in pencil also have the problem of writing so softly that their answers are too light to read. When an answer is impossible to read, readers usually call upon their table leader to help them interpret it and, if the answer is still seen as illegible, it will not receive points.

So, rather than writing their answers in tiny print, students should write their work and answers in the appropriate areas of the exam, after the question. For long written responses, the amount of room between the sub-questions is entirely insufficient. And for long mathematical questions, students trying to squeeze their work into that small space will suffer lost points if the reader can’t find key numbers and logical work that is labeled and clear.

If students want to ensure they will receive maximum points, they should write all the answers in one location, and only write their answers once! So many students write their correct answers next to the question, realize they have extra paper, and then decide to transfer their work over. The problem is, a large fraction of those students transpose answers incorrectly, or give entirely new answers. So now many students have two sets of different answers.

All mathematical questions require work, even if the question doesn’t explicitly say so. Readers cannot award points for correct answers if there isn’t at least a set-up given. This year, I read a two-point question that required students to convert molarity and volume to mass. The students were awarded one point for finding moles and a second for finding the mass. Students can easily find the correct answers in their calculator, but if they only recorded one of these results (e.g., 7.91g), they received no points. Instead, they had to show work, along the lines of 0.10000L \* 0.500M = 0.0500mol and 0.0500mol \* 158.1g/mol = 7.91g (significant figures were not graded on this question). Students received one point for the initial mole calculation and the second for the mass calculation.

If there is a place for students to draw particle diagrams, Lewis structures, graphs, or any other images, and the student makes a mistake within that area, they are more than welcome to cross it out and redraw it on the extra paper. Crossed-out answers are never read.

Understanding what the question is asking

Students may not understand the question prompts. It is important for students to know what “key prompts” mean, such as those outlined the table below. Many teachers may find teaching prompt vocabulary is not within the scope of AP Chemistry, believing that the students should already know what these terms mean. But if you want your students to perform to their best ability, it is important to outline the expectations of each prompt, so the students know exactly what to provide in their answer. The following chart has a small list of prompts that have been seen in the more recent exam questions. In the “meaning” column is how I explain that particular prompt in my classes.

|  |  |
| --- | --- |
| Prompt | Meaning |
| Justify your answer | Show all math work and explain how one knows the answer, using new information not presented in the question. |
| State evidence | Use information from the question (data chart, graph, etc.) to prove a statement and provide reasoning, including new connections not already provided in the question.  NOTE: Remember that “state evidence” is different from “justify” in most cases, because the question is specifically asking the students to refer to given information. |
| Calculate | Show all work for each answer, using the appropriate equation, significant figures, and units. |
| Explain | Make clear by describing in more detail with new relevant facts. |
| Represent | Draw or model the description provided.  NOTE: A particle diagram and specific directions often accompany this prompt, indicating how the student should draw the particles, as well as how many particles to draw. Students must follow the rules to obtain credit. |
| Identify | Select the correct answer.  NOTE: Generally speaking, a short answer will suffice. No justification is needed. |
| Estimate | The value has a range of answers, but must be within an acceptable range and include proper significant figures.  NOTE: If the glassware shown in the question reads to the hundredths place, the estimate must have the hundredths place value as well. |
| In terms of | Use the following words in the explanation along with new relevant details that connect to the terms.  NOTE: Have students underline the terms required and, after answering the question, check to be sure they used the terms or synonyms. |
| According to the graph | Find evidence in the graph that explains the phenomenon and explain your reasoning. |

For example, I graded question 1(e)(ii) from the 2018 exam that required students to convert a previous answer to kJ/molrxn and “include the appropriate algebraic sign with your answer.” An alarming number of students obtained the correct value, but never provided the correct negative sign. And because the question required the algebraic sign, readers could not accept the term “released,” or award full points to any answer that did not also include the negative sign. Additionally, in question 1(d) of the exam, students were asked, “According to the graph, what is the temperature change of the reaction mixture?” Unfortunately, hundreds of students answered this question by stating something to the effect of, “the curve of the graph increases and then plateaus,” and failed to receive points because they never provided numerical answers.

The AP exam is not wrong. This is something some students battle with. Question 1(f) of the exam asked: “The magnitude of the enthalpy change calculated from the results of the second experiment is the same as the result calculated in part (e)(i). Explain this result.” Many students refuted this statement, saying the fictional student described in the question must have done the second trial incorrectly, and as a result, there were no points awarded. The students should have explained the comparison by mentioning that both the magnitude of heat, and the amount of moles, increased by the same factor — and that when divided to obtain kJ/mol, the factors canceled.

However, if a different question asks students to “agree or disagree” with a statement, this is when a student could claim in their answer that the statement is incorrect. For example, the 2018 exam question 2(c) read: “The student hypothesizes that increasing the temperature will increase the amount of N2O3(g) in the equilibrium mixture. Indicate whether you agree or disagree with the hypothesis. Justify your answer.” I have heard from fellow readers of question 2 this year that many students answered the question vaguely and never actually indicated whether they agreed or disagreed — thus earning no points. So make sure your students have practice with these types of questions.

#### Topical themes recognized in recent years

Overall, when I reflect on the last few years of the redesigned exam, and talk with fellow readers, there seem to be a few subtopics that AP item writers like to include. To name a few:

* pKa=pH at half equivalence point
* comparison of intermolecular forces that are not obvious (when London Dispersion Forces are stronger than dipole)
* skeletal Lewis electron-dot diagrams that require electrons to be added
* Coulomb’s Law descriptions and comparisons
* half-life for 1st order reactions
* photoelectron spectra
* glassware needed for various labs (usually acid/base labs)
* particle diagrams
* graphical analysis
* lab error analysis

And although the exam no longer has a question dedicated to net ionic questions, those are still very relevant, coming up twice in the free-response section in 2018. This is not an exhaustive list; feel free to add to this list and the discussion on the AACT platform.

I hope you have found the reflection and pointers beneficial, and that you can incorporate some of the ideas in your own teaching. Personally, having read the exam two years in a row, I have walked away with so many new ideas and insights that I wanted to share them with other AP Chemistry teachers. I recommend looking into becoming a reader (for details, visit the [College Board website](https://apcentral.collegeboard.org/professional-development/become-an-ap-reader))! Most teachers I have met at the reading say that reading the AP Chemistry Exam is the best professional development experience they have ever had.

If you have questions or tips about preparing your students for the Advanced Placement Chemistry Exam, please share them with us on the [discussion forum](https://teachchemistry.org/discussions) of the AACT website.