Calculations in Chemistry for General Chemistry

39 Chapter *Beta* Text

Starting on page 6 below is the Table of Contents for *Calculations in Chemistry for General Chemistry*. These 1,250 pages of homework tutorials (printed in three paperback volumes) include the content in *Calculations in Chemistry – An Introduction*, but go on to cover most of the additional topics of AP and college general chemistry that include calculations.

The text is designated as *beta* because copy-editing has been limited, but the content has been edited and used successfully with students.

Calculations is currently in two editions.

- *Calculations in Chemistry – An* ***Introduction*** is available from W. W. Norton as a 24 chapter, 550 page paperback text and eBook for high school class sets or college bookstore orders, as well as for retail purchase online and at bookstores.
- *Calculations in Chemistry for* ***General Chemistry*** is available as a "custom publication" as a 39 chapter, 1,250 page text in 3 paperback volumes for high school class sets or college bookstore orders (no eBook or retail version is currently available).

College instructors who adopt and instructors at high schools purchasing class sets of either the 24 or 39 chapter editions of *Calculations* may request copies of quizzes that cover all chapters of each text. To request quizzes, send an email to Feedback@ChemReview.Net .

The methodology of the two texts is similar. The introductory edition covers fewer topics and is designed to help students *prepare* for topics in general or AP chemistry.

Which version is a good fit for which courses? The sections below

- Compare the 24 and 39 chapter versions and discuss factors to consider in choosing a text for college or AP classes, and
- Describes how instructors can obtain an examination copy of the 39-chapter text.

For College Courses

Preparatory Chemistry

In experiments conducted by Dr. Mary Mumper at Frostburg State University (MD), students with "below average preparation" for general chemistry based on placement measures were scheduled into a "preparatory chemistry" course that used *Calculations – Introduction* as a text. Dr. Mumper reported significantly improved completion rates for and grades in subsequent general chemistry compared to prior cohorts with similar levels

of preparation who had not completed the preparatory course. Her report is included in Reference #1 below.

In a "preparatory" chemistry course, the authors believe the inexpensive (under $50) *Calculations* paperback should be the only text students need. The text is focused on the area where students in general chemistry tend to encounter the most difficulty: calculation problems. In our experience, during general chemistry, with the help of more graphical (and more expensive to produce) standard general chemistry texts, students learn *qualitative* knowledge without much difficulty. Where they tend to stumble is in the math of general chemistry.

Since 1990 in many states, "K-12 math standards" have de-emphasized computation topics. Recent cognitive studies stress that skill in mathematical calculations requires "overlearned" pre-requisite math (References 2, 3, 4). *Calculations - Introduction* is designed to help students over-learn relevant math "just-in-time" for topics in chemistry.

General/Organic/Biochem (GOB) Chemistry

In "GOB" courses for health-science majors, students will need a standard GOB text for organic, biochemistry, and qualitative topics in general chemistry. Where Calculations will help as an inexpensive supplement in the computation topics that often challenge students in courses required for health-science majors.

College General Chemistry

In a number of experiments to improve general chemistry achievement, the 39 chapter edition of *Calculations* has been used for homework assignments in both general and engineering chemistry. Articles by instructors who have used and evaluated the 39-chapter *Calculations* text are in References 5 and 6 below.

Topics in the 39 chapter text follow the "math-early" sequence of most general chemistry textbooks, but the modular format supports an "atoms-first" sequence as well.

General chemistry instructors have a choice of assigning homework from *Calculations – Introduction* or *Calculations – Gen Chem*. The recommendation of the authors would be

- If the tutorials are intended to "refresh memory" of high school math and chemistry fundamentals, *Calculations – Introduction* would be helpful at many points in first semester, and some points in second-semester, general chemistry.
- If the tutorials are utilized to move a significant percentage of lecture content to homework, opening more time for "active learning" during lecture, the more extensive *Calculation – Gen Chem* would be a better choice for first and especially second semester.

In "hybrid" or "online" sections of general chemistry, the "self-study" format and extensive topic coverage of *Calculations – Gen Chem* will be especially helpful to students. In Amazon reviews, student comments have been especially positive about the *Calculations* methodology when used for self-study.

As detailed in the Table of Contents below, *Calculations – Gen Chem* covers nearly all of the quantitative topics in general chemistry, as well as many qualitative topics that require step-by-step procedures.

For most courses, students will need Volumes 1 and 2 for first-semester general chemistry, and Volumes 2 and 3 for second semester, but instructors may want to check the Table of Contents to be certain this is the case for their topic sequence.

If students in general chemistry have taken a preparatory course that completed most of *Calculations – Introduction*, they will see some overlap between *Calculations – Intro* and *Calculations -Gen Chem* Volume 1. *Calculations – Gen Chem* is designed on the assumption that for the current generation, even for students who place out of a preparatory course will likely have some need for topics in the *Intro* book. For students from diverse backgrounds, it is difficult to predict which topics those will be, so all *Intro* topics are covered in the *Gen Chem* edition (at a faster pace). The higher frequency of "pre-tests" built into in the "Gen Chem" edition will help students move quickly past topics they know and spend time where "refreshing memory" may be needed.

In *Calculations – Gen Chem* Volume 1, about 25% of the content is beyond what is covered in the *Intro* text. Students are likely to encounter those additional topics in general chemistry.

For AP Chemistry

The initial drafts of the 1,250 pages of tutorials were made available online for testing by students and instructors. Over 20 reviews of the lessons by AP instructors are posted at:

www.ChemReview.Net (in column 3).

Choosing a Text

In AP chemistry, which text should be chosen -- the 550 page *Calculations – Intro*, or the 1,250 page *Calculations – Gen Chem* -- will depend on your teaching situation. The following factors may influence your decision:

- Achievement in AP and general chemistry is assisted by a rigorous *first-year* preparation course. During Chem I, if homework from the 550 page *Calculations – Introduction* can be coordinated with lecture and assigned at a gradual pace to reinforce in-class instruction, students should be very well prepared for the more advanced topics in general/AP chemistry and *Calculations – Gen Chem*.

  If students have completed most of *Calculations – Intro* during Chem I, the 39 chapter *Calculations – Gen Chem* would provide a fast "refreshing of memory" on Chem I *plus* homework support for most topics in AP.

- If circumstances permit, an AP "summer packet" will also speed progress. For content, we would suggest assignment of homework "self study" in either *Calculation – Intro* if it has not been completed, or if it has, *Calculations – General Chem* Volume One.

- In both cases, consider assigning lessons up to and including stoichiometry.

- The often self-described as challenged students who wrote the Amazon reviews learned by their self-study in *Calculations*. Students entering AP should have no difficulty doing so.

- One of the goals of the *Calculations* project is to improve the efficiency of learning during "study time." The 1,250 pages of *Calculations – Gen Chem* assume substantial "study time."

  Students in high school are generally in classes for about 30 hours a week, as opposed to 18 hours for college students. This high school schedule provides *some* time for homework tutorials, but less time than college students. High school students may also have less practical access to quiet study locations such as libraries. For students taking more than one AP course, study time may also be at a premium. This suggests that coverage of topics via AP homework may need to be selective compared to homework assigned at the college level.

- The suggestion of the authors would be that if most students in an AP section have *not* previously completed the 550 page *Calculations – Intro* paperback or eBook, the *Intro* would be a good place to start experiments with homework tutorials. If those are used extensively with success, Volumes 2 and/or 3 from the gen chem edition might also be obtained for AP topics later in the course.

Acquiring Paperbacks

The 1,250 page *Calculations – Gen Chem* is available in three paperback volumes, but is not available as an eBook.

Most public high schools are set up to purchase *hardback* texts to *loan* to students for 6+ years. Science instructors, however, are often permitted to purchase less expensive paperbacks as lab manuals, with expectation that the shorter paperback half-life is offset by lower cost.

If you wish to experiment with use of *Calculations – Gen Chem*, we suggest you order a class set of one or more volumes and loan them to students as you would a paperback lab manual. Let them know they have a choice: they can choose not to write in the book and return it, or write in it, "lose it," and pay for it at the end of the year. Each paperback will likely cost the school about $ 40 – an inexpensive textbook price.

Examination Copies of *Calculations – Gen Chem*

The 1,250 page *Calculations in Chemistry for General Chemistry* is currently available as three paperback volumes.

- **Volume 1, Modules 1-16** (**ISBN** 978-0-393-12552-8) 416 pages
- **Volume 2, Modules 17-27** (**ISBN** 978-0-393-12553-5) 416 pages
- **Volume 3, Modules 28-39** (**ISBN** 978-0-393-12554-2) 432 pages

Detailed topic coverage is listed below.

Examination copies of each of the three volumes, plus information on ordering class sets or bookstore orders, are available by email request to ChemReviewTeam@ChemReview.Net . (Include titles and ISBN numbers in the bullets above.)

References

1. Dahm, D., Mumper, M., Nelson, E.: "Beta-Testing New Approaches For First-Year Chemistry Instruction" at http://www.chemreview.net/CCCEnewsl-DahmMumperNelson.pdf
2. Mason, D., et al.: "MUST -Know Pilot—Math Preparation Study from Texas" at https://confchem.ccce.divched.org/content/2017fallconfchemp2
3. Leopold, D., Edgar, B.: Degree of mathematics fluency and success in second-semester introductory chemistry. *J. Chem. Ed*. 85, 724 (2008)
4. Hartman, J., Nelson, E.: "Automaticity in Computation and Student Success in Introductory Physical Science Courses" at http://arxiv.org/abs/1608.05006
5. Craig, P., "Building Student Confidence with Chemistry Computation" at https://confchem.ccce.divched.org/content/2017fallconfchemp5
6. Hartman, J., Dahm, D, Nelson, E: ConfChem conference on flipped classroom: Time-saving resources aligned with cognitive science. J. Chem. Ed. 92.9 (2015): 1568-1569 and at http://confchem.ccce.divched.org/2014SpringConfChemP2

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