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Christopher R. Hren

with John T. Moore, EdD

Peter J. Mikulecky, PhD

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and Peter J. Mikulecky, PhD

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Introduction

Chemistry is at once practical and wondrous, humble and majestic. And for someone studying it for the first time, chemistry can be tricky and rather challenging in some spots.

That's why we wrote this book. It is designed to be an all-encompassing companion for you as you journey through the wonderful yet sometimes confusing world of chemistry. It is going to help you work through anything you might need in your class or whatever you want to investigate further in the wide chemical world.

Chemistry is sometimes called the central science (mostly by chemists), because in order to have a good understanding of biology or geology or even physics, you must have a good understanding of chemistry. We live and work in a world of chemistry, and after your journey is complete, hopefully you won't find the word *chemistry* so frightening.

About This Book

This book is a one-stop chemistry shop. Each chapter explains key concepts covered in any high school or introductory college chemistry class, along with example problems and opportunities for practice. You'll find the absolute basics that you need to succeed in a chemistry course, all the way up to some rather complicated material.

One thing that will stand out to you is all of the calculations throughout the book. Chemistry has a lot of math in it, and this book doesn't shy away from that. The beginning chapters of this book, though, are going to

help you make sure you are comfortable working through the calculations you'll see throughout the rest of it, so make sure you don't skip over those if you think you need a little review. Once you are past those you're going to see every major chemistry topic covered that you're likely to encounter:

Each new topic provides

- Example problems with answers and solutions
- Practice problems with answers and solutions

Each chapter provides

- An end-of-chapter quiz with problems representing the topics covered
- Solutions to those quiz questions

Online quizzes are also available for even more practice and confidence-building.

Foolish Assumptions

Because you're interested in this book, we assume you probably fall into one of a few categories:

- You're a student taking a high school chemistry course or a student in college taking an introductory chemistry class and are just not even sure where to start.
- You're a parent of a student taking chemistry in high school and are trying to help your kid out with their chemistry but need some brushing up.
- You're just naturally curious about science and mathematics and you want to get a little more

acquainted with chemistry.

We also assume that you can add, subtract, multiply, and divide numbers without any real issue, but that you will still use a calculator for all this stuff. Calculators are there for a reason, and they are helpful, so please use them!

Icons Used in This Book

In this book, I use these five icons to signal what's most important along the way:

EXAMPLE Each example is an algebra question based on the discussion and explanation, followed by a step-by-step solution. Work through these examples, and then refer to them to help you solve the practice test problems at the end of the chapter.

REMEMBER This icon points out important information that you need to focus on. Make sure you understand this information fully before moving on. You can skim through these icons when reading a chapter to make sure you remember the highlights.

TIP Tips are hints that can help speed you along when answering a question. See whether you find them useful when working on practice problems.

WARNING This icon flags common mistakes that students make if they're not careful. Take note and proceed with caution!

YOUR TURN When you see this icon, it's time to put on your thinking cap and work out a few practice problems on your own. The answers and detailed solutions are available so you can feel confident about your progress.

Beyond the Book

In addition to what you're reading right now, this book comes with a Cheat Sheet that provides quick access to some formulas, rules, and processes that are frequently used. To get this Cheat Sheet, simply go to www.dummies.com and type **Chemistry All-in-One For Dummies Cheat Sheet** in the Search box.

You'll also have access to online quizzes related to each chapter. These quizzes provide a whole new set of problems for practice and confidence-building. To access the quizzes, follow these simple steps:

1. **Register your book or ebook at Dummies.com to get your PIN.** Go to www.dummies.com/go/getaccess.
2. **Select your product from the drop-down list on that page.**
3. **Follow the prompts to validate your product, and then check your email for a confirmation**

message that includes your PIN and instructions for logging in.

If you do not receive this email within two hours, please check your spam folder before contacting us through our Technical Support website at http://support.wiley.com or by phone at 877-762-2974.

Now you're ready to go! You can come back to the practice material as often as you want — simply log on with the username and password you created during your initial login. No need to enter the access code a second time.

Your registration is good for one year from the day you activate your PIN.

Where to Go from Here

This book is organized so that you can safely move from whichever chapter you choose to start with and in whatever order you like. You can strengthen skills you feel less confident in or work on those that need some attention.

If you need some help with scientific notation, unit conversions, or otherwise feel you could use a little practice on the math side of things then we recommend strongly that you look over Chapters 1 and 2. Those are going to get you ready for all of the other material you'll see throughout the book. After that Chapters 3, 4, and 5 are going to give you a solid grounding in matter, atoms, and the world-renowned periodic table. Those are probably where you're going to be starting in almost any chemistry class you encounter, so those are likely going to be a great place to begin your journey.

Beyond that, check out whatever chapters you might need help with. Each chapter is designed to be self-sufficient and will walk you through whatever material you need to understand a particular topic. Do keep in mind, though, that different aspects of chemistry are very much interrelated. Even though a chapter might be set up to be self-contained, there are likely going to be things in that chapter you are assumed to understand from previous chapters. The concepts you learn in chemistry rarely go away; they pop up again and again when you're learning new material so don't hesitate to look back at whatever you might need to review.

You can use the table of contents at the beginning of the book and the index in the back to navigate your way to the topic that you need to brush up on. Regardless of your motivation or what technique you use to jump into the book, you won't get lost because you can go in any direction from there.

Enjoy!

Unit 1

Getting Started with Chemistry

In This Unit ...

Chapter 1

Looking at Numbers Scientifically

IN THIS CHAPTER

- **Using scientific notation**
- **Comparing accuracy and precision**
- **Using and calculating with significant figures**
- **Working with quantitative and qualitative data**

Like any other kind of scientist, a chemist tests hypotheses by doing experiments. Better tests require more reliable measurements, and better measurements are those that have more accuracy and precision. Accurate and precise calculations are essential to successful experiments, so a large chunk of chemistry centers on ways to report and describe measurements.

How do chemists report their precious measurements? What's the difference between accuracy and precision? And how do chemists do math with measurements? These questions may not keep you awake at night, but knowing the answers to them will keep you from making mistakes in chemistry.

Using Exponential and Scientific Notation to Report Measurements

Because chemistry concerns itself with ridiculously tiny things like atoms and molecules, chemists often find themselves dealing with extraordinarily small or extraordinarily large numbers. Numbers describing the distance between two atoms joined by a bond, for example, run in the ten-billionths of a meter. Numbers describing how many water molecules populate a drop of water run into the trillions of trillions.

To make working with such extreme numbers easier, chemists turn to scientific notation, which is a special kind of exponential notation. In *exponential notation,* a number is represented as a value raised to a power of 10. The decimal point can be located anywhere within the number as long as the power of 10 is correct.

Suppose that you have an object that's 0.00125 meters in length. Express it in a variety of exponential forms:

$$0.00125\ \text{m} = 0.0125 \times 10^{-1}\ \text{m, or}$$
$$0.125 \times 10^{-2}\ \text{m, or}$$
$$1.25 \times 10^{-3}\ \text{m, or}$$
$$12.5 \times 10^{-4}\ \text{m, and so on}$$

All these forms are mathematically correct as numbers expressed in exponential notation. But in scientific notation the decimal point is placed so that only one digit other than zero is to the left of the decimal point. In the preceding example, the number expressed in scientific notation is $1.25 \times 10^{-3}\ \text{m}$. Most scientists express numbers in scientific notation.

In scientific notation, every number is written as the product of two numbers, a coefficient and a power of 10. In plain old exponential notation, a coefficient can be any value of a number multiplied by a power with a base of 10 (such as 10^4). But scientists have rules for coefficients