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Physics FOR DUMMIES®

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by Steven Holzner

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About the Author

Steven Holzner is an award-winning author of 94 books that have sold over two million copies and been translated into 18 languages. He served on the Physics faculty at Cornell University for more than a decade, teaching both Physics 101 and Physics 102. Dr. Holzner received his Ph.D. in physics from Cornell and performed his undergrad work at MIT, where he has also served as a faculty member.

Dedication

To Nancy.

Author's Acknowledgments

Any book such as this one is the work of many people besides the author. I'd like to thank my acquisitions editor, Stacy Kennedy, and everyone else who had a hand in the book's contents, including Natalie Harris, Josh Dials, Joe Breeden, et al. Thank you, everyone.

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Contents at a Glance

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Introduction

Physics is what it's all about.

What *what's* all about?

Everything. That's the whole point. Physics is present in every action around you. And because physics has no limits, it gets into some tricky places, which means that it can be hard to follow. It can be even worse when you're reading some dense textbook that's hard to follow.

For most people who come into contact with physics, textbooks that land with 1,200-page whumps on desks are their only exposure to this amazingly rich and rewarding field. And what follows are weary struggles as the readers try to scale the awesome bulwarks of the massive tomes. Has no brave soul ever wanted to write a book on physics from the *reader's* point of view? Yes, one soul is up to the task, and here I come with such a book.

About This Book

Physics For Dummies is all about physics from *your* point of view. I've taught physics to many thousands of students at the university level, and from that experience, I know that most students share one common trait: confusion. As in, "I'm confused as to what I did to deserve such torture."

This book is different. Instead of writing it from the physicist's or professor's point of view, I write it from the reader's point of view. After thousands of one-on-one tutoring sessions, I know where the usual book presentation of this stuff starts to confuse people, and I've taken great care to jettison the top-down kinds of explanations. You don't survive one-on-one tutoring sessions for long unless you get to know what really makes sense to people — what they want to see from *their* points of view. In other words, I designed this book to be crammed full of the good stuff — and *only* the good stuff. You also discover unique ways of looking at problems that professors and teachers use to make figuring out the problems simple.

Conventions Used in This Book

Some books have a dozen conventions that you need to know before you can start. Not this one. All you need to know is that new terms appear in italics, like *this,* the first time I discuss them and that vectors — items that have both a magnitude and a direction — appear in bold in Chapter 4, like **this.**

What You're Not to Read

I provide two elements in this book that you don't have to read at all if you're not interested in the inner workings of physics — sidebars and paragraphs marked with a Technical Stuff icon.

Sidebars are there to give you a little more insight into what's going on with a particular topic. They give you a little more of the story, such as how some famous physicist did what he did or an unexpected real-life application of the point under discussion. You can skip these sidebars, if you like, without missing any essential physics.

The Technical Stuff material gives you technical insights into a topic, but you don't miss any information that you need to do a problem. Your guided tour of the world of physics won't suffer at all.

Foolish Assumptions

I assume that you have no knowledge of physics when you start to read this book. However, you should have some math prowess. In particular, you should know some algebra. You don't need to be an algebra pro, but you should know how to move items from one side of an equation to another and how to solve for values. Take a look at Chapter 2 if you want more information on this topic. You also need a little knowledge of trigonometry, but not much. Again, take a look at Chapter 2, where I review all the trig you need to know — a grasp of sines and cosines — in full.

How This Book Is Organized

The natural world is, well, *big.* And to handle it, physics breaks the world down into different parts. The following sections present the various parts you see in this book.

Part I: Putting Physics into Motion

Part I is where you usually start your physics journey, because describing motion — including acceleration, velocity, and displacement — isn't very difficult. You have only a few equations to deal with, and you can get them under your belt in no time at all. Examining motion is a great way to understand how physics works, both in measuring and predicting what's going on.

Part II: May the Forces of Physics Be with You

"For every action, there is an equal and opposite reaction." Ever heard that one? The law, and its accompanying implications, comes up in this part. Without forces, the motion of objects wouldn't change at all, which would make for a very boring world. Thanks to Sir Isaac Newton, physics is particularly good at explaining what happens when you apply forces.

Part III: Manifesting the Energy to Work

If you apply a force to an object, moving it around and making it go faster, what are you really doing? You're doing *work,* and that work becomes the *energy* of that object. Together, work and energy explain so much about the whirling world around us, which is why I dedicate Part III to these topics.

Part IV: Laying Down the Laws of Thermodynamics

What happens when you stick your finger in a candle flame and hold it there? You get a burned finger, that's what. And you complete an experiment in heat transfer, one of the topics you see in Part IV, a roundup of thermodynamics — the physics of heat and heat flow. You also see how heat-based engines work, how ice melts, and more.

Part V: Getting a Charge out of Electricity and Magnetism

Part V is where the zap! part of physics comes in. You see the ins and outs of electricity, all the way down to the component electrons that make action

happen and all the way up to circuits with currents and voltages. Magnetism is a pretty attractive topic, too. When electricity flows, you see magnetism, and you get its story in Part V, including how magnetism and electricity form light.

Part VI: The Part of Tens

Parts of Tens are made up of fast-paced lists of 10 items each, and physics can put together lists like no other science can. You discover all kinds of amazing relativity topics here, such as time dilation and length contraction. And you see some far-out physics — everything from black holes and the Big Bang to wormholes in space and the smallest distance you can divide space into.

Icons Used in This Book

You come across some icons in this book that call attention to certain tidbits of information. Here's what the icons mean:

This icon marks information to remember, such as an application of a law of physics or a shortcut for a particularly juicy equation.

This icon means that the info is technical, insider stuff. You don't have to read it if you don't want to, but if you want to become a physics pro (and who doesn't?), take a look.

When you run across this icon, be prepared to find a little extra info designed to help you understand a topic better.

Where to Go from Here

You can leaf through this book; you don't have to read it from beginning to end. Like other *For Dummies* books, this one has been designed to let you skip around as you like. This is your book, and physics is your oyster. You can jump into Chapter 1, which is where all the action starts; you can head to Chapter 2 for a discussion on the necessary algebra and trig you should know; or you can jump in anywhere you like if you know exactly what topic you want to study.

Part I

Putting Physics into Motion