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# **Physics Essentials**

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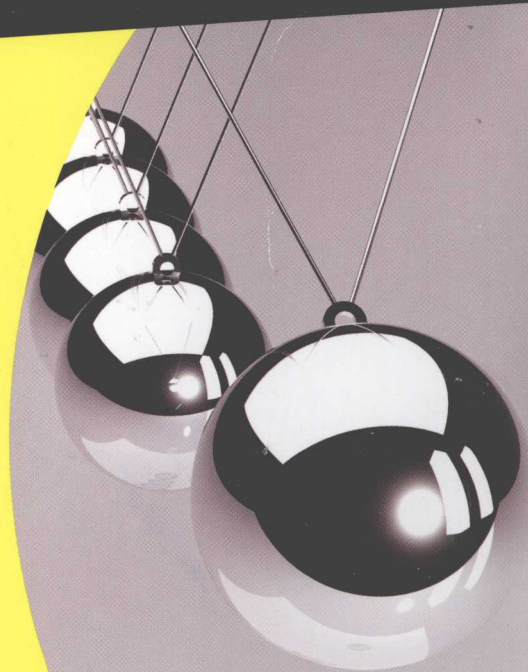
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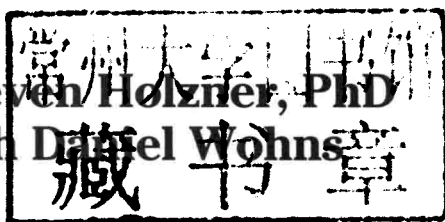


**Steven Holzner, PhD**

*Author of Quantum Physics For Dummies*

# *Physics Essentials* FOR DUMMIES®

by Steven Holzner, PhD  
with Daniel Wohns



  
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## Physics Essentials For Dummies®

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***Physics***  
***Essentials***  
FOR  
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**Steven Holzner** is an award-winning author of 94 books that have sold over 2 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 PhD in physics from Cornell and performed his undergrad work at MIT, where he has also served as a faculty member.

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# Contents at a Glance

.....

Introduction .....	1
Chapter 1: Viewing the World through the Lens of Physics .....	5
Chapter 2: Taking Vectors Step by Step .....	15
Chapter 3: Going the Distance with Speed and Acceleration .....	25
Chapter 4: Studying Circular Motions .....	41
Chapter 5: Push-Ups and Pull-Ups: Exercises in Force .....	49
Chapter 6: Falling Slowly: Gravity and Friction .....	63
Chapter 7: Putting Physics to Work .....	77
Chapter 8: Moving Objects with Impulse and Momentum .....	95
Chapter 9: Navigating the Twists and Turns of Angular Kinetics .....	111
Chapter 10: Taking a Spin with Rotational Dynamics .....	127
Chapter 11: There and Back Again: Simple Harmonic Motion .....	139
Chapter 12: Ten Marvels of Relativity .....	159
Index .....	169

# Contents



<b>Introduction .....</b>	<b>1</b>
About This Book .....	1
Conventions Used in This Book .....	2
Foolish Assumptions .....	2
Icons Used in This Book .....	3
Where to Go from Here .....	3
 <b>Chapter 1: Viewing the World through the Lens of Physics .....</b>	 <b>5</b>
Figuring Out What Physics Is About .....	5
Paying Attention to Objects in Motion .....	6
Getting Energized .....	7
Moving as Fast as You Can: Special Relativity .....	8
Measuring Your World .....	9
Keeping physical units straight .....	10
Converting between units of measurement .....	10
Nixing some zeros with scientific notation .....	12
Knowing which digits are significant .....	12
 <b>Chapter 2: Taking Vectors Step by Step .....</b>	 <b>15</b>
Getting a Grip on Vectors .....	15
Looking for direction and magnitude .....	16
Adding vectors .....	17
Subtracting vectors .....	18
Waxing Numerical on Vectors .....	19
Working with Vector Components .....	20
Using magnitudes and angles to find vector components .....	20
Using vector components to find magnitudes and angles .....	22
 <b>Chapter 3: Going the Distance with Speed and Acceleration .....</b>	 <b>25</b>
From Here to There: Dissecting Displacement .....	26
Examining axes .....	27
Measuring speed .....	28
The Fast Track to Understanding Speed and Velocity .....	29
How fast am I right now? Instantaneous speed .....	30
Staying steady: Uniform speed .....	30





Changing your speed: Nonuniform motion .....	30
Doing some calculations: Average speed .....	31
Contrasting average speed and instantaneous speed .....	32
Speeding Up (or Slowing Down): Acceleration .....	33
Defining our terms .....	34
Recognizing positive and negative acceleration .....	34
Looking at average and instantaneous acceleration .....	35
Accounting for uniform and nonuniform acceleration .....	35
Bringing Acceleration, Time, and Displacement Together .....	36
Locating not-so-distant relations .....	37
Equating more speedy scenarios .....	38
Putting Speed, Acceleration, and Displacement Together .....	39
<b>Chapter 4: Studying Circular Motions .....</b>	<b>41</b>
Understanding Uniform Circular Motion .....	41
Creating Centripetal Acceleration .....	43
Seeing how centripetal acceleration controls velocity .....	44
Calculating centripetal acceleration .....	44
Finding Angular Equivalents for Linear Equations .....	45
<b>Chapter 5: Push-Ups and Pull-Ups:     Exercises in Force .....</b>	<b>49</b>
Reckoning with Force .....	49
Objects at Rest and in Motion: Newton's First Law .....	50
Calculating Net Force: Newton's Second Law .....	52
Gathering net forces .....	53
Just relax: Dealing with tension .....	57
A balancing act: Finding equilibrium .....	58
Equal and Opposite Reactions: Newton's Third Law .....	61
<b>Chapter 6: Falling Slowly: Gravity and Friction .....</b>	<b>63</b>
Dropping the Apple: Newton's Law of Gravitation .....	63
Down to Earth: Dealing with Gravity .....	65
Leaning Vertically with Inclined Planes .....	66

Facing Friction.....	68
Figuring out the normal force .....	69
Finding the coefficient of friction .....	70
Bringing static and kinetic friction into the mix .....	71
Getting moving with static friction .....	71
Staying in motion with kinetic friction .....	72
Dealing with uphill friction.....	73
Calculating the component weight .....	74
Determining the force of friction.....	74
<b>Chapter 7: Putting Physics to Work .....</b>	<b>77</b>
Wrapping Your Mind around Work .....	77
Pushing your weight.....	78
Taking a drag.....	79
Working Backward: Negative Work .....	80
Working Up a Sweat: Kinetic Energy .....	81
Breaking down the kinetic energy equation.....	83
Using the kinetic energy equation.....	84
Calculating kinetic energy by using net force.....	85
Saving Up: Potential Energy.....	87
Working against gravity.....	88
Converting potential energy into kinetic energy .....	89
Pitting Conservative against Nonconservative Forces .....	90
No Work Required: The Conservation of Mechanical Energy.....	92
A Powerful Idea: The Rate of Doing Work.....	93
<b>Chapter 8: Moving Objects with Impulse and Momentum .....</b>	<b>95</b>
Feeling a Sudden Urge to Do Physics: Impulse .....	95
Mastering Momentum .....	97
Connecting Impulse and Momentum.....	98
Taking impulse and momentum to the pool hall.....	99
Getting impulsive in the rain .....	100
Watching Objects Go Bonk: The Conservation of Momentum.....	101
Measuring Firing Velocity .....	103
Examining Elastic and Inelastic Collisions.....	105
Flying apart: Elastic collisions .....	106
Sticking together: Inelastic collisions .....	106
Colliding along a line .....	107
Colliding in two dimensions.....	108

## **Chapter 9: Navigating the Twists and Turns of Angular Kinetics .....111**

Changing Gears (and Equations) from Linear to Rotational Motion.....	111
Tackling Tangential Motion.....	112
Calculating tangential speed.....	113
Figuring out tangential acceleration.....	114
Looking at centripetal acceleration.....	115
Applying Vectors to Rotation.....	116
Analyzing angular velocity.....	116
Working out angular acceleration.....	117
Doing the Twist with Torque.....	119
Walking through the torque equation.....	120
Mastering lever arms.....	122
Identifying the torque generated.....	123
Realizing that torque is a vector.....	124
No Spin, Just the Unbiased Truth: Rotational Equilibrium.....	125

## **Chapter 10: Taking a Spin with Rotational Dynamics .....127**

Converting Newton's Second Law into Angular Motion.....	127
Moving from tangential to angular acceleration.....	129
Bringing the moment of inertia into play.....	129
Finding Moments of Inertia for Standard Shapes.....	131
Doing Rotational Work and Producing Kinetic Energy.....	132
Making the transition to rotational work.....	133
Solving for rotational kinetic energy.....	134
Going Round and Round with Angular Momentum.....	136

## **Chapter 11: There and Back Again: Simple Harmonic Motion .....139**

Homing in on Hooke's Law.....	139
Staying within the elastic limit.....	140
Exerting a restoring force.....	141
Déjà Vu All Over Again: Simple Harmonic Motion.....	142
Browsing the basics of simple harmonic motion.....	142
Exploring some complexities of simple harmonic motion.....	144
Breaking down the sine wave.....	145
Getting periodic.....	147

Studying the velocity .....	149
Including the acceleration.....	150
Finding angular frequencies of masses on springs .....	152
Examining Energy in Simple Harmonic Motion.....	154
Going for a Swing with Pendulums .....	156
<b>Chapter 12: Ten Marvels of Relativity .....</b>	<b>159</b>
Nature Doesn't Play Favorites.....	159
The Speed of Light Is Constant .....	160
Time Contracts at High Speeds.....	161
Space Travel Slows Down Aging .....	162
Length Shortens at High Speeds .....	162
Matter and Energy Are Equivalent: $E = mc^2$ .....	163
Matter + Antimatter Equals Boom .....	164
The Sun Is Losing Mass .....	164
You Can't Surpass the Speed of Light .....	164
Newton Was Right.....	165
<b>Index .....</b>	<b>169</b>

# Introduction

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**p**hysics 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 Essentials 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. Here's all you need to know:

- ✓ New terms appear in italic, like *this*, the first time I discuss them. If you see a word in italic, look for a definition close by.
- ✓ Physicists use several different *measurement systems*, or ways of presenting measurements. (See how the italic/definition thing works?) In Chapter 1, I introduce the most common systems and explain that I use the meter-kilogram-second (MKS) system in this book. I suggest that you spend a few minutes with the last section of Chapter 1 so you're familiar with the measurements you see in all the other chapters.
- ✓ *Vectors* — items that have both a magnitude and a direction — appear in bold, like **this**. However, when I discuss the magnitude of a vector, the variable appears in italic.

## Foolish Assumptions

I assume that you have very little knowledge of physics when you start to read this book. Maybe you're in a high school or first-year college physics course, and you're struggling to make sense of your textbook and your instructor.

I also assume that you have some math prowess. In particular, you should know some algebra, such as how to move items from one side of an equation to another and how to solve for values. You also need a little knowledge of trigonometry, but not much.

## Icons Used in This Book

You come across two icons in the left margins of 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.



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

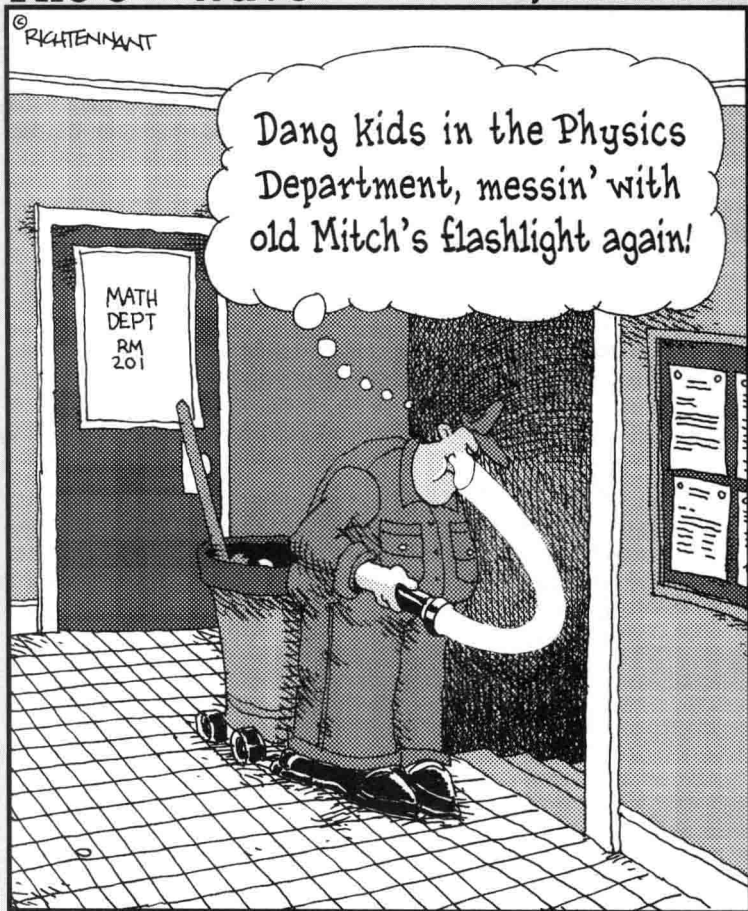
## Where to Go from Here

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 vector algebra you should know; or you can jump in anywhere you like if you know exactly what topic you want to study. For a taste of how truly astounding physics can be, you may want to check out Chapter 12, which introduces some of the amazing insights provided to us by Einstein's theory of special relativity.

# The 5<sup>th</sup> Wave

By Rich Tennant





## Chapter 1

# Viewing the World through the Lens of Physics

---

### *In This Chapter*

- ▶ Recognizing the physics in your world
  - ▶ Getting a handle on motion and energy
  - ▶ Wrapping your head around relativity
  - ▶ Mastering measurements
- 

**P**hysics is the study of your world and the world and universe around you. You may think of physics as a burden — an obligation placed on you in school. But in truth, physics is a study that you undertake naturally from the moment you open your eyes.

Nothing falls beyond the scope of physics; it's an all-encompassing science. You can study various aspects of the natural world, and, accordingly, you can study different fields in physics: the physics of objects in motion, of forces, of what happens when you start going nearly as fast as the speed of light, and so on. You enjoy the study of all these topics and many more in this book.

## *Figuring Out What Physics Is About*

You can observe plenty going on around you all the time in the middle of your complex world. Leaves are waving, the sun is shining, the stars are twinkling, light bulbs are glowing, cars