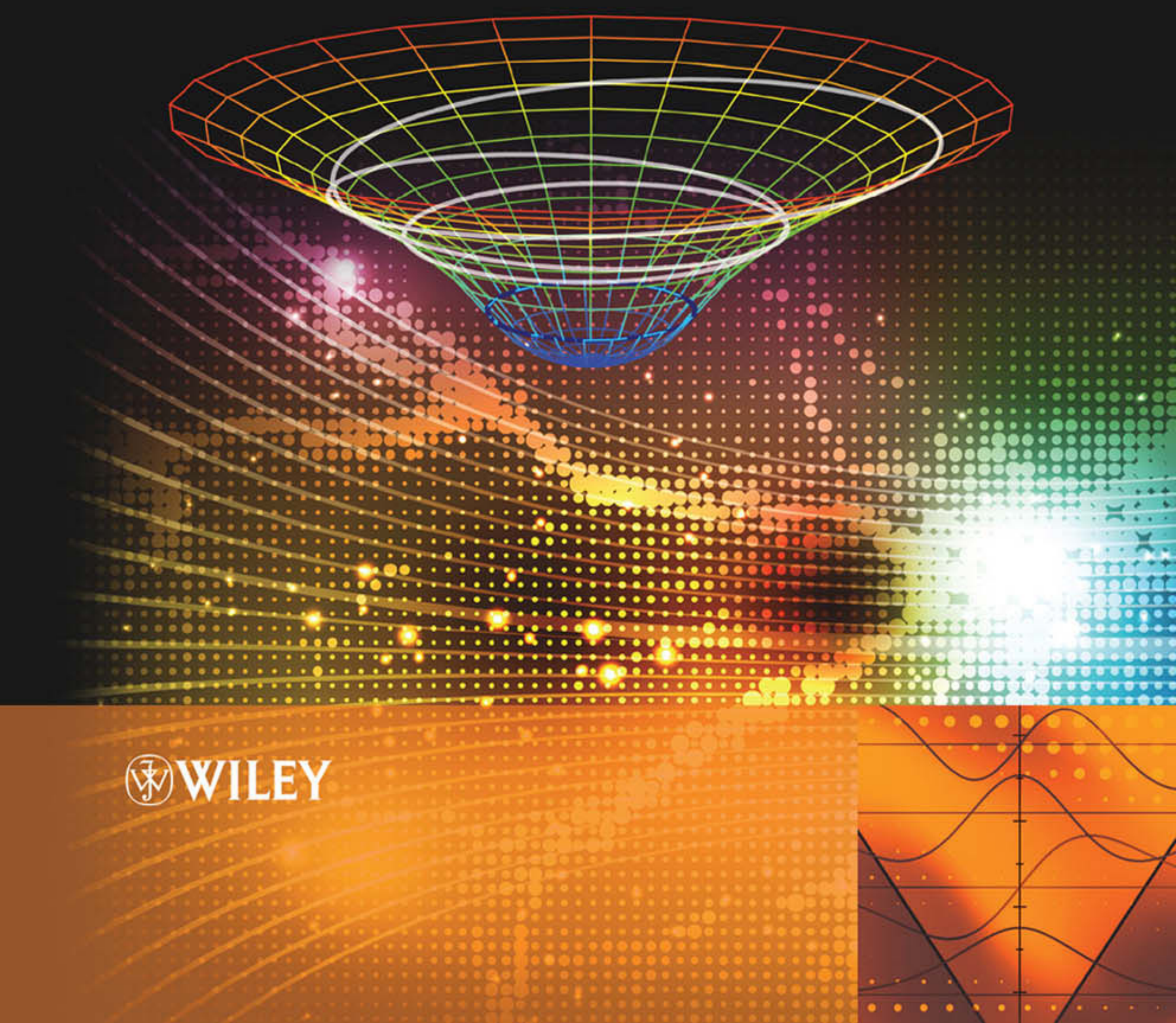
DOING

PHYSICS

WITH SCIENTIFIC NOTEBOOK™

A PROBLEM-SOLVING APPROACH

JOSEPH GALLANT



WILEY

Doing Physics
with
Scientific Notebook

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A Problem-Solving Approach

Joseph Gallant

University of Massachusetts

Amherst, MA, USA

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A John Wiley & Sons, Ltd., Publication

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This edition first published 2012

Registered office
John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

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Library of Congress Cataloging-in-Publication Data

A catalogue record for this book is available from the Library of Congress.

A catalogue record for this book is available from the British Library.

Print ISBN: 978-0470-665978 (Cloth) 978-0470-665985 (Paper)

Set in 10 point Times New Roman by the author with Scientific WorkPlace.

“It’s *all* physics!”

Donny MacNamara

Contents

Preface

Welcome to the wonderful world of physics! The study of physics is useful and important because physics is the most fundamental science. It is the framework upon which other sciences are built. As my old friend the high school physics teacher used to say "It's ***all*** physics!" Once you understand the basic principles of physics, you'll find it easier to understand other sciences. The thinking and problem-solving skills you develop here will help you in any endeavor.

This goal of this book is to teach undergraduate physics students how to use *Scientific Notebook* to solve physics problems. I've tried to choose topics that have educational value, fit within a typical physics curriculum, and show the benefits of *SNB*. Many problems come from my class notes, some from my research, while others I included because they're interesting. Some are problems I wanted to do in class but couldn't because the math was too difficult or time consuming.

Solving real-world problems usually requires more complicated mathematics than the idealized problems presented in introductory textbooks. Those "easy" problems are a good place to start. Once you can solve and understand them, we'll add some complications and let *SNB* do the math. This lets us solve interesting, more realistic problems, and this book will be a useful reference for your entire undergraduate career.

Many of you are training for careers in fields which require technical or scientific calculations and written reports. *SNB*, which you can think of as a combination math gizmo and word processor, is ideally suited for these tasks. You'll find this inexpensive software helpful and easy to use, in the classroom and beyond. However *SNB* can only assist you in solving physics problems, it cannot solve them for you.

Physics is not math. In mathematics you learn to solve equations. In physics you learn to apply equations to describe and explain the physical universe. Physicists construct equations involving physical quantities that are based on fundamental principals to describe and explain nature and we use mathematics to solve them. The bad news is that *SNB* will not solve any physics problems for anyone. The good news is that is will help you do physics by helping you with the math stuff. You do the physics, *SNB* does the math. You create the equation, *SNB* solves it. *SNB* will make the graph, but you will have to interpret it.

Undergraduate physics is taught with varying degrees of mathematical rigor, from freshmen no-calculus science-major courses to upper-level lots-of-calculus courses for physics majors. Not all physics classes use calculus so many students learn physics without it. But omitting calculus from a book about *Doing Physics with SNB* is like warping with one nacelle tied behind your impulse drive. The calculus and no-calculus problems are usually in separate sections, with the more complicated sections at the ends of chapters.

In Chapter 1, I introduce you to many *SNB* features I have used to solve physics problems. There are many more features of *SNB*, and the best way to learn them is to explore and play with *SNB*. Excellent written documentation accompanies *SNB* and it has an extensive built-in help system, all of which was written with *SNB*. If you see it in the help, you can do it with *SNB*. You can even cut-and-paste from the help into your document. The Help + Search feature is a great place to start when you need help or information.

In the subsequent chapters, I follow the basic introductory physics curriculum, extending it to include interesting problems (some with calculus but all at the undergraduate level) that show the power and usefulness of *SNB* and let your skills grow. Each section has a brief introduction to the relevant physical concepts. Since this is not a comprehensive physics textbook, I emphasize problem solving over conceptual knowledge, although both are important.

At least one example appears in almost every section. Their purpose is to enhance your understanding of the relevant physics and to provide detailed instructions on using *SNB*. You can (and should) explore the topics further with the wide selection of problems at the end of each chapter.

The two Appendices at the end of the book contain special topics in classical and modern physics that are not typically part of the traditional undergraduate physics curriculum. These are topics I find interesting, important or curiosity-inducing. They also show just how powerful *SNB* is as a problem-solving tool.

This book uses the following notation and conventions:

- The abbreviation *SNB* refers to *Scientific Notebook*. Really.
- Words written like Evaluate and Plot 2D Rectangular refer to *SNB* menu commands, buttons, and options.
- Notation like Compute + Evaluate means click on the Compute menu item and select Evaluate.
- Notation like Help + Search, Tags means click on the Help menu item and select Search. When the input box appears, type Tags.
- Words written like TAB and CTRL refer to a key on your keyboard.
- Notation like CTRL + F means hold down the CTRL key, press the F key and release the two keys simultaneously.
- Important physics words like **force** appear in bold face the first time you meet them.
- Shaded gray boxes contain *SNB* output.

> This is a box of output!

I made every calculation and graph in this book with *Scientific Notebook* 5.50 (Build 2960). To write this book, I used *Scientific WorkPlace* 5.50 (Build 2960), which has all of *SNB*'s computational capabilities plus the LaTeX typesetting system. To create the final PDF file, I used Pdf 995 (version 10.2).

So we're all on the same page...

For the most part, I've left *SNB*'s default settings unchanged. There is one important exception. Under the Tools menu item, on the General page of Engine Setup, you will find the Solve Options. The default setting for Principal Value only and Ignore Special Cases is unchecked, which when solving equations can lead to output from *SNB* that looks like this:

$ax^2 + bx + c = 0$, Solution is:

$$\begin{cases} \mathbb{C} & \text{if} \quad a = 0 \wedge b = 0 \wedge c = 0 \\ \emptyset & \text{if} \quad c \neq 0 \wedge a = 0 \wedge b = 0 \\ \left\{-\frac{1}{b}c\right\} & \text{if} \quad b \neq 0 \wedge a = 0 \\ \left\{-\frac{1}{2a}\left(b - \sqrt{-4ac + b^2}\right), -\frac{1}{2a}\left(b + \sqrt{-4ac + b^2}\right)\right\} & \text{if} \quad a \neq 0 \end{cases}$$

This answer is correct ($\mathbb{C}$ is the set all complex numbers, $\emptyset$ is the empty set, the $\wedge$ symbol means "and") and you could cut-and-paste the parts you want. But as is, it's cumbersome and contains too much information to be helpful to most students. To simplify the output, let's check both Principal Value only and Ignore Special Cases and solve the equation again.

$ax^2 + bx + c = 0$, Solution is: $-\frac{1}{2a}\left(b - \sqrt{b^2 - 4ac}\right)$

As you can see, *SNB* returns only the first answer and considers none of the special cases. Checking Ignore Special Cases while leaving Principal Value only unchecked produces this output.

$ax^2 + bx + c = 0$, Solution is: $-\frac{1}{2a}\left(b - \sqrt{b^2 - 4ac}\right), -\frac{1}{2a}\left(b + \sqrt{b^2 - 4ac}\right)$

Unless otherwise stated, the Solve Options I use in this book are Ignore Special Cases checked and Principal Value only unchecked.

There are a few not-so-important exceptions as well, which are more a matter of style and preference than substance. I made the following minor adjustments to the default settings.

- Under Tools + User Setup, choose the Math page, click the Radical button, and choose the Square Root button on the left.
- Under Tools + Computation Setup, choose the 2D Plots page. Click Rectangular and set the Default Plot Interval from zero to five.
- On the same page, click Polar and set the Default Plot Interval from zero to 6.2832 (about 2π).
- On the Plot Layout page, set the Screen Display and Plot Attributes to Plot Only and choose Displayed for the Placement option.

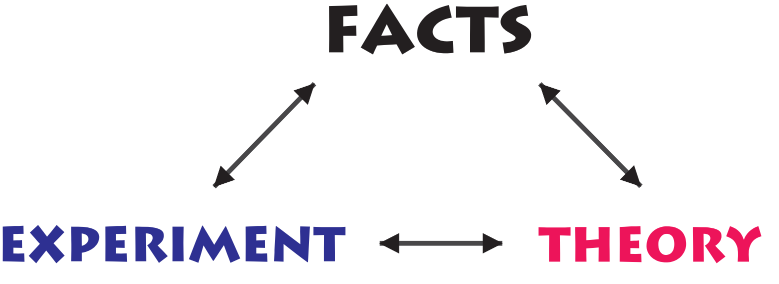
I keep *SNB*'s default setting of five digits in its output. Beyond this, I make no attempt to do significant figures, which I leave to the instructors. To make a global change for the number of digits in your answers, go to Tools + Computation Setup, choose the General page and change the Digits Shown in Results setting.

What is science?

Science is a systematic process to obtain and explain the facts to answer questions about the physical universe. Science is something you do. The fundamental precept of science is "look first, then decide". To be scientific, you can't make up your mind and then look for corroborating facts. You must carefully and rigorously gather the facts first, and then you analyze and interpret them. This prevents you from taking a few anecdotes and interpreting them as evidence. In science, "anecdotal evidence" is an oxymoron.

Experience suggests the universe operates under cause-and-effect laws. Contrary to the views espoused by many TV detectives, coincidences are real and they do happen. Take care not to mistake the occasional coincidence for a cause-and-effect relationship. You also must be careful not to assume something is inexplicable because you can't explain it. The difference between "I don't know" and "it's not knowable" is huge. The former is a wonderful beginning; the latter is a dead end. Science minimizes these mistakes.

The three parts of **science** are **experiment**, **theory**, and the **facts**.



Experiments play two roles. They obtain the facts and they test the predictions of a theory. Experimenters make careful, controlled measurements to collect data. In science not all information rises to the level of data, much like not all information rises to the level of evidence in a courtroom. An experiment must be repeatable and verifiable. There is no "take my word for it" in science.

There is no truth in science either. Truth is subjective but the facts are objective. When you seek the truth, the response you get depends on who or how you ask. The facts do not depend on who or how you ask. Suppose two people decide to settle an argument with a race. When they return person A says "I won and he lost" while person B says "I finished just behind the person that won and she finished just ahead of the person that came in last". Who is telling the truth? They both are telling a version of the truth. The facts are person A ran the race in 10 seconds and person B ran the race in 11 seconds.

A scientific theory must do two things. It must explain the known facts and predict new facts that can be measured experimentally. This ensures that the theory is not simply "aimed" at only known facts. A theory is rigorous, detailed, and mathematical. A theoretical result is much more than a hypothetical idea. Don't say "I have a theory" when you only have an idea or a guess and don't say "theoretically" when you mean "hypothetically".

To the Student

Many of you are just beginning to learn physics. Perhaps you have heard that physics is a difficult course. Many students, even those who have had success in other subjects, are frightened by the prospect of taking physics for a grade. Physics is simple to *understand* but sometimes it's difficult to *learn*. Difficult, but not impossible. Ultimately you hold the key to your success and there are several ways you can help yourself.

- **Read your Textbook**
  Physics books are not novels and you might not understand everything you read the first time through. Use your text book (and this book) as a resource to look stuff up and to review. Some students prefer to read the text before the lecture, others after the lecture, some even do both. You must find the way that works best for you. Either way, you will find many answers and insights in your text.
- **Ask Questions**
  If there is something in the class or the text that is not clear, *please* ask! Do not be embarrassed. You're in a physics class and the room is full of people who don't understand. Yet.
- **Work Together**
  Students who study with other students often are more successful. One of the best ways to improve your own understanding of a concept is to explain it to someone else. But remember, the purpose of a study group is to exchange ideas not answers!
- **Seek Help**
  Some problems take more than 15 minutes to solve. Don't give up! Here's a rule of thumb: if you spend a good hour working on a problem, put it aside and visit your professor. Bring your work, as often an expert can see a small error that was preventing your success. Visit your professor, teacher, or graduate assistant with questions, comments, or just to talk physics.
- **Time Is Not Always On Your Side**
  Physics is best learned in small doses. You don't know in advance which problems will be the most time consuming, so budget your time wisely. Waiting until the last minute and trying to cram is not a good strategy. Avoid falling into the "due Monday means do Sunday" trap.
- **Pay More Than Attention**
  Physics is more a skill rather than a collection of facts. Solving physics problems is a skill, and like all skills it must be learned by doing. You cannot learn a skill by reading about it or by listening to your professor talk about it in a lecture. This is as true for riding a bicycle as it is for learning physics. How much and how well you learn physics depends mostly on the time and effort you put forth. Educators guide you, encourage you, offer you our insights. It's up to you to actually learn the physics.

In other words, as in most things in life worth doing, success in learning physics requires hard work and effort.

In most physics courses, you are required to solve word problems. There is no guaranteed recipe for successful problem solving. It is a skill that you must acquire through practice. But I can offer a few words of advice about problem solving.

- Read the problem carefully! The biggest problem with word problems is the words.
- Ask yourself two important questions: "what do I know?" and "what am I trying to find?".
- Draw a picture! Visualizing the problem will help you solve it.
- Do the math correctly. *SNB* will help you with this step.
- Check your units. Are the units right?
- Is the answer reasonable?

There is much more to do than just the math.

The problems at the end of the chapters are rarely "*SNB* problems" any more than problems in other physics books are calculator problems. After Chapter 1, there are very few *SNB* problems in this book. Most of the problems are physics problems. Remember that *SNB* is a tool and we want to ***do*** something with it.

To the Teacher

SNB has many features that teachers will find useful. You can use *SNB* to write homework assignments, exams, and solutions. You can use it to write your class notes and post them on the web so your students can access them with the Open Location command. *SNB* uses text files that are easily emailed so you and your students can exchange questions and answers.

You can create your own document types (ideal for lab reports or in-class worksheets) with the Export Document command. *SNB* exports the document as a shell file and treats it as a template. When your students click the New button, your preferred formats appears as one of their options.

We all try to be available and encourage our students to contact us. When they do, I usually use *SNB* to answer their questions. This is not the traditional approach, and the soulless minions of orthodoxy may not approve, but it seems to work.

When given a math or physics problem to solve with *SNB*, students often treat it as an *SNB* problem. Remind them *SNB* is a tool and the goal is to use that tool to do something.

Contact Information

If you have any questions, comments or suggestions about this book, please feel free to contact me directly at DPwSNB@gmail.com and I'll respond as quickly as I can.

To find the book's website, go to http://booksupport.wiley.com/ and search for this book by my name or the title. Once you're there, you'll find the *DPwSNB* e-book, the solutions manual, PowerPoint files containing all the figures in this book, and any other goodies we conjure up.

Acknowledgments

There are many people I'd like to thank for their help that made this book possible.

Barry MacKichan, President of *MacKichan Software, Inc.*, graciously responded to my initial overtures about publishing this book and turned the matter over to this staff. Patti Kearney put me in contact with the good people at Wiley. John MacKendrick and George Pearson of MacKichan Support thoroughly answered my many questions.

Many people at Wiley contributed much time and effort to this project. Christoph von Friedeburg, then Commissioning Editor for Physics, was an early and enthusiastic supporter. Jenny Cossham was the Publisher who successfully presented my proposal to the publications committee. Sarah Tilley was my Project Editor and primary contact for the last year of this project when most of the work happened. She skillfully managed every aspect of this project and did so with charm and wit. Zoë Mills, Assistant Editor and mother of the cutest pumpkin ever, oversaw the design of the book's attractive cover. Judith Egan-Shuttler, my copy editor with an extraordinary eye for detail, found many mistakes but was always gracious and gentle when pointing them out.

John Brehm was my former modern physics professor and a great teacher and author. He was also my undergraduate advisor and his simple "so where are you going to grad school?" question started this journey. His insights and suggestions improved this book immeasurably. John Dubach was my professor and the best dissertation advisor anyone could want. Barry Holstein, another former professor and quantum gator, generously gave me his time and expertise on relativity.

I'd like to thank Mike Crescimanno and John Fisher for many stimulating conversations on all thing physics, more than a few of which ended up in this book. I'm grateful to Sal Caronite for his friendship and sharing his unique perspective and keen observations on the human condition, including mine.

Over the years, many of my students were able helpers and guinea pigs. This includes my daughter Lisa, who was my student when this book was nothing more than a small handout. Our many interesting conversations and wonderful, delightful adventures are but small parts of her contribution to my life and this book.

Finally, I'd like to thank the rest of my family for encouraging and supporting me when I needed it, and for giving me the time and space to write. Words alone cannot express the gratitude and thanks I owe my mother. My wife Patti's love and support for me and this project have been unwavering. Such debts can never be paid.

Joseph Gallant .... *February 2012*

1 Introduction to SNB

The main activity of most physics classes is to teach students how to solve physics problems. Mathematics is a tool we use to solve those problems. Many of the difficulties students have in physics classes are rooted in the mathematics. They can't see the forest of physics for all the mathematical trees. *Scientific Notebook* (*SNB*) is a powerful yet easy-to-use computer algebra system that can help alleviate this problem. *SNB* is inexpensive and easy enough to be accessible to most undergraduates yet powerful enough to be useful in solving interesting physics problems.

The goal of this book is to teach students how to use *SNB* to solve physics problems. Once you have learned how (and it won't take all that long), you will use *SNB* as its name implies – as a *notebook* in which you set up a science or math problem, write and solve an equation, analyze and discuss the results. Of course a regular notebook will never help you do the math, but *SNB* will. Soon you will be able to think and write at the computer, in much the same way you use a paper and pencil now, with the power of a computer algebra system at your disposal.

Why SNB?

Scientific Notebook is powerful software that combines word processing and mathematics in standard notation with the power of symbolic computation. You enter the mathematical expressions in a form that is familiar to you and *SNB* evaluates it. This is the key to *SNB*. All the mathematics are in ***standard notation*** in a form that is ***familiar to you***. There is no arcane syntax to learn.

Consider a quick analysis of the function $y = x^2 e^{-3x} \sin 4x$. What is the area under the curve? Where is the function zero? What does the function look like? You may know how to find the answers, but you might have trouble doing the necessary mathematics. With *SNB*, one click gives the exact answer and a second click gives an approximate numerical answer.

$$\int_0^\infty x^2 e^{-3x} \sin 4x \, dx = \frac{88}{15\,625} = 5.632 \times 10^{-3}$$

With one click, *SNB* will find the first zero of the function.

$0 = x^2 e^{-3x} \sin 4x$, Solution is: 0

As you might have guessed, this function equals zero at $x = 0$.

Doing Physics with Scientific Notebook: A Problem-solving Approach, First Edition. Joseph Gallant.

You can see the other zeros with a plot of the function. It would be simple to graph this function by hand, but tedious and time consuming. To see a 2-dimensional plot of this function with *SNB*, we can again click a single button.

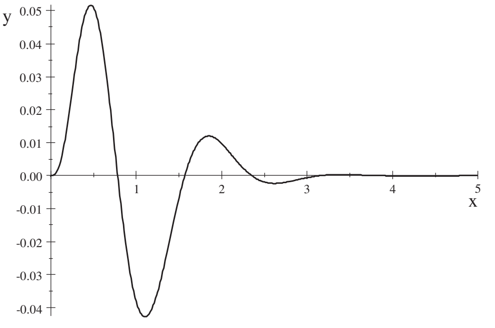


Figure 1.1 A plot of $x^2e^{-3x}\sin 4x$

Later in this chapter you'll learn how to find the other zeros.

Once we created the expressions, which was very easy to do, all it took was a few mouse clicks to answer our three questions. The entire process took about a minute. With *SNB*'s help, you will be able to spend more time thinking about physics and less time worrying about mathematics. However, keep in mind that *SNB* can only help you solve physics problems, it can not solve them for you.

This chapter presents a brief introduction to *SNB*, emphasizing features you will use in your physics class. It explains how to perform basic tasks such as entering and editing mathematics and text, solving equations and how to compute and plot mathematics. You can even use *SNB* to open and save documents available on the Internet. Keep in mind the main advantage of *SNB* over other systems. It is easy to learn and easy to use yet powerful enough to do physics. Before you start *Doing Physics with SNB*, you need to know how to use *SNB*.

The Basics

When you start *SNB*, you see a typical Windows interface containing menus, icons, and other graphics. This interface allows you to interact with the "brains" of *SNB*, the engine. The engine is the program which performs all the mathematical calculations. In version 5.5 of *SNB*, the engine is MuPAD (version 3.1). *SNB* translates your input into a form the engine can understand, sends it to the engine, translates the engine's output into a form you can understand, and shows it to you.

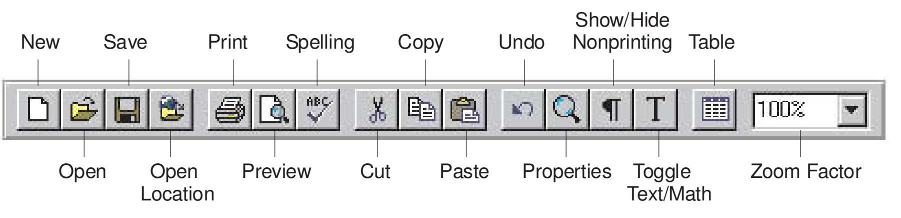
Since *SNB* uses a standard interface, all the editing techniques you use in other programs will work in *SNB*. If you are new to computing, all the editing techniques you learn here will be useful in other applications. The blinking vertical line on your screen is called the insertion point, and it marks the position where characters or symbols are entered when you type or click a symbol. You can change the position of the insertion point with the arrow keys, or by clicking a different screen position with your mouse. The position of the mouse is indicated by the mouse pointer, which takes the shape of an `I`-beam over text and an arrow over mathematics.

Some actions in *SNB* require you to select, or highlight, text or mathematics. When you make a selection with the mouse or the keyboard, the next action you take affects the selection. To select an individual word or mathematical object with the mouse, double-click the word or object. To make a large selection with the mouse you can either click-and-drag the pointer with the left mouse button down, or click the mouse at the start of the selection, press and hold SHIFT, move the pointer to where you want the selection to end, click the mouse and release SHIFT. For more information on selecting, look under Help + Search, Selecting Text and Mathematics.

You can access many of *SNB*'s features from various toolbars. You can display or hide any of the toolbars and you can return the toolbar display to its original setting. Also, you can dock the toolbars in the program window, let them float on the screen, or reshape them according to your preference. Use the following steps to display or hide toolbars.

1. Go to the View menu and choose Toolbars.
2. Check the box for each toolbar you want to display.
3. Choose Close. If you choose Reset, you will restore the default toolbar display.

The Standard Toolbar contains most of the commands you will need to manage files and to edit and manipulate text and mathematics in your *SNB* documents. Many of these are probably familiar to you. The Open (CTRL + O) command opens an existing file and the Save command saves the active file and keeps it open. You can Cut (CTRL + X), Copy (CTRL + C) and Paste (CTRL + V) text, mathematics, and graphics.



The *SNB* interface is not what-you-see-is-what-you-get, so use the Preview button to see what the printed document will look like before you Print (CTRL + P) it. The Zoom Factor only affects the on-screen appearance of your document and has no effect on the printed version.

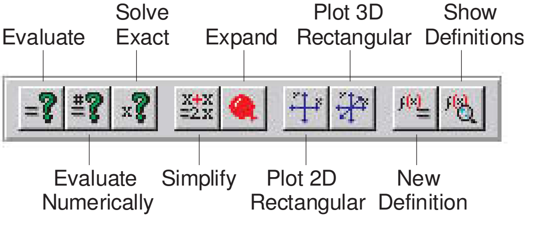
As anyone who has ever graded papers will tell you, it is a good idea to check the Spelling in your document before printing. With the Spelling tool you can check the spelling in a selection, from the insertion point to the end of the document, or in the entire document. You can even check the spelling of a single word by selecting it and clicking the Spelling button. A spell check does not check mathematics or words embedded in mathematics.

The Standard Toolbar also includes some *SNB* commands, including the important Math/Text toggle button. With the New command you can create a new file by selecting the type of document from a list of shells provided with *SNB*. Each shell is a template for a different type of *SNB* document. You can create your own shells by using File + Export Document to place any *SNB* document as a shell file in one of the Shells folders. Once there, your new file will appear in the shell list displayed when you start a new document. If you have a required format for lab reports, you could create a shell file organized in that format. When you need to write a lab report, click New and choose that shell. You can even create new shell folders to organize your shells. For more information on creating shells, look in Help + Shells, Creating a Document Shell.

The Open Location command allows you to open an existing *SNB* file that is posted on the web as long as you know its URL. Look in the Preface to this book for any information on a website.

By changing the Properties of any text or mathematical object, you can alter the behavior of mathematical objects and the appearance of your document. Select the item you want to adjust and click the Properties button. A context-sensitive dialog box will appear that allows you to change the properties of the item. If you don't select anything, *SNB* chooses the item to the left of the insertion point. Any changes you make only affect that item.

The Compute Toolbar contains many commands you will use to carry out mathematical calculations. These are the commands you'll use most often to solve physics problems.

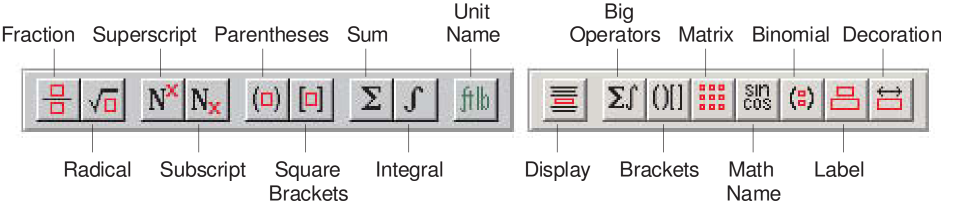


This chapter devotes significant time and space to these important commands and your success using *SNB* depends on you doing the same.

The Stop Toolbar contains a single button

that you can use to stop two operations, linking to the Internet and performing computations. You can also stop these operations by pressing CTRL + BREAK. The Stop operation is not available from a menu.

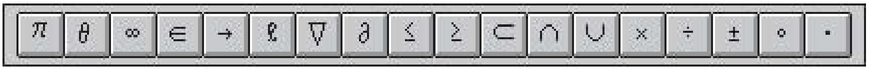
Before you carry out any calculations, you need to create mathematical expressions using the mathematical objects on the Math Templates and Math Objects toolbars.



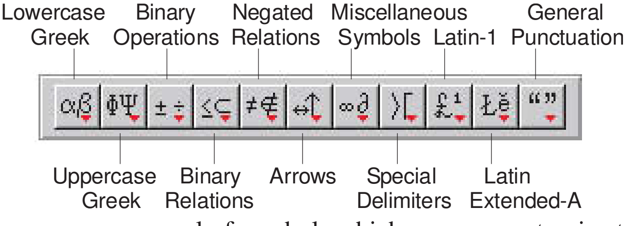
Math Templates Math Objects

Notice the Table button is not here (it is on the Standard Toolbar). Both tables and matrices are two-dimensional arrays of boxes called cells. Each cell of a table can hold mathematics, text, or graphics. But a table is not a mathematical object, so you can't perform mathematical computations on a table as a whole as you can on a matrix. A good rule of thumb in *SNB*: matrices are for numbers and tables are for words.

The Symbol Cache contains 18 commonly used mathematical symbols

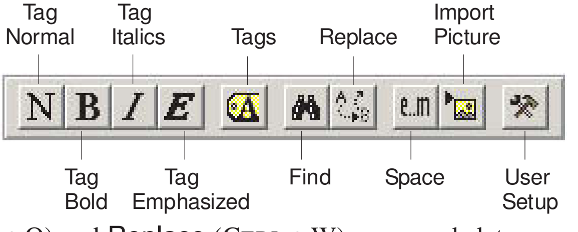


including two reserved symbols (π and ∞) and the times sign ($\times$) used in multiplication and scientific notation. You will also find these symbols and more in the Symbol Panels.



Each button opens a popup panel of symbols which you can customize to remain open all the time or dock in a different location. For a detailed look at the symbols on each panel, look under Help + Search, Symbol Panels.

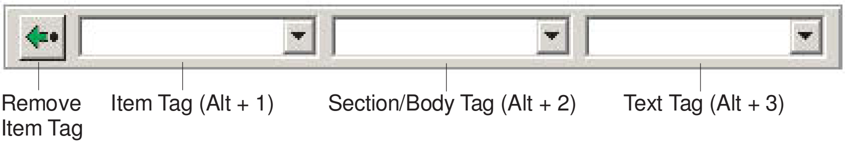
The buttons on the Editing Toolbar allow you to alter the appearance of the text in your document. The first four buttons apply frequently used Text Tags: Normal, **Bold**, *Italics*, and ***Emphasized***. To change the appearance of your text, select the text and click one of these four buttons.



The Find (CTRL + Q) and Replace (CTRL + W) commands let you search for and replace text or mathematics in your document. You can search for all occurrences of any combination of mathematics and text, including those with a specific Tag. You can also access the Find and Replace commands from the Edit menu.

With User Setup you can customize many of *SNB*'s default values. From the User Setup dialog box, you can choose which shell *SNB* uses as the start-up document, set the properties of mathematical objects and operations, the properties of new graphics, tables and matrices, and many other general program properties. Be *very* careful when you alter any settings with User Setup. The changes you make with it are global and affect every document you open. Use Compute + Settings to make local changes that affect the current document only.

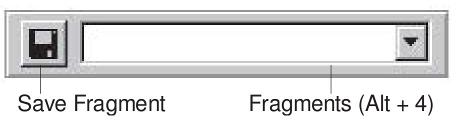
The Tag Toolbar consists of three popup lists that contain all the item tags, section and body tags, and text tags available for the current shell. With these tags, you can organize your document and alter its appearance.



As we saw earlier, the Text Tags alter the appearance of text. Besides the four on the Editing Toolbar, you can find more Text Tags in the right-hand popup list of the Tag Toolbar. When you click the Text Tag popup box (or press ALT + 3), a list of all available text tags pop up.

The middle popup list contains Section/Body Tags. You can use the various headings, centered text, and quotations to organize your document. You can apply Item Tags to create various kinds of lists. With the Numbered List Item tag you can create a list of items that are automatically numbered sequentially. With the Bullet List Item tag you can create a list of items that are preceded by a bullet. All the numbered and bulleted lists in this book were created with Item Tags. The Description List Item tag allows you to create a customized text label for each item on your list.

The Fragment Toolbar offers an easy way to save and access frequently used expressions or equations. A fragment contains information (text, mathematics or both) that has been saved in a separate file for later recall. You can import a previously saved fragment into the current document, or you can save information in the current document as a new fragment. A fragment saved in one document is available to all documents. The Fragment Toolbar consists of the Save Fragment button and the fragment popup box.



When you click the fragment popup box (or press ALT + 4), a list of fragments that you can insert in your document pops up. *SNB* comes with many predefined fragments, including an extensive list of physical constants.

It is very easy to import a fragment into your document.

1. Place the insertion point where you want the fragment to appear.
2. Click the fragment popup box (or press ALT + 4).
3. Click on the fragment you want to import.

You can also use File + Import Fragment... menu item. Just select the fragment you want from the Import Fragment dialog box and choose OK. When you import a fragment, its contents are pasted into your document at the insertion point.