
Supporting Materials

The **Manual for Instructors** contains solutions to all exercises, with extended comments on the even-numbered problems. There are also notes on each chapter for classroom use. Ordering information is provided for *DERIVE* and other calculus software. For graphing calculators we highly recommend the books by Dennis Pence.

The Manual comes to faculty on request, and is sent automatically on adoption. It may be ordered by readers who are using the text for self-teaching.

The **Student Study Guide** provides additional worked examples, which are coordinated section by section with the text. It also contains supplementary drill problems and completed solutions to all “read-through questions.” Selected even-numbered problems from each section are solved.

Chapter 1 of the Study Guide is reproduced at the end of this text. The full Guide can be ordered through bookstores or directly from Wellesley-Cambridge Press.

WELLESLEY-CAMBRIDGE PRESS

A note about the book’s production and publication, because Wellesley-Cambridge is a small press. Its size makes no difference to the printer and bookstore. They do their part equally for all publishers. Each step is normal—and the response can be fast. When the author stays involved, the book is ready a year sooner. ***Most important, the connection between author and reader is not broken.***

Since our press was founded in 1985, hundreds of readers have sent encouragement. We feel part of a larger effort, which certainly lies behind this book. So does the need, widely expressed, for a fresh approach to the teaching of calculus.

Because the press has few spokesmen, the book has to speak for itself. We depend on teachers who like it to say so. If the direction is right, support will come. What counts in the end is in the classroom and study. All we can do is our best—and mathematics deserves it.

Acknowledgements

Five names were mentioned in the Preface, but so many others have helped. I finish this book uplifted by the encouragement and the example of good teachers. The Boston Workshops have brought hundreds of friendships, and I particularly thank Florence Ashby, Richard Barshinger, Dick Dowds, Leonard Gambler, Steve Kuhn, Dick Metzler, Yves Nievergelt, Thurmon Whitley, and Lee Zia—and Frank Morgan.

The whole experience leaves one incurably optimistic, to see the power of ideas. That is certainly true in mathematics, where the sharing is so generous. Here is my only public way to express gratitude:

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This book has been a joint effort, like everything we do. I hope very much that the pleasure of writing it will be felt by the reader.

To the Student

I hope you will learn calculus from this book. On this page I will admit that I even hope for more. If you find that the explanations are clear, and also the *purpose* is clear—that means you see not only equations but ideas. Then the book was worth writing, and the course is a success.

I am trying to say that this subject is alive. As long as there are problems to solve, mathematics will keep growing. It is not wrapped up inside some giant formula! We want to know the chance of winning the Florida lottery (Chapter 2), and the meaning of an electrocardiogram (Chapter 3), and where we are on the population **S**-curve. I see no reason to pretend that mathematics has all the answers. The book is really the life story of an idea—which isn't finished.

Most of mathematics is about patterns and functions. There is a pattern in the graphs on the back cover (which I don't understand). There is a pattern in the slopes of x^2 and x^3 and x^n (which you will understand). They change as x changes. Every function contains a whole history of growth or decay. The pattern is sometimes clear and sometimes hidden—the goal is to find it.

The reader will understand that calculus is not all sweetness and light. There is work to do. You absolutely have to solve problems—and think carefully. As one of my students said, “*My God, I have to read the words.*” I guess that's true, and I hope the words come to the point. The book will try not to waste your time. Its object is not to “cover” material, but to uncover and explain it. In the end, teaching a subject comes down to teaching a person.

It is not easy to stay inspired for a year—probably impossible. But mathematics is more active and cheerful than most people know. This book was written in a happy spirit, with a serious purpose—I hope you enjoy it.

A SMALL REWARD

Some mistakes may have crept into the solutions. I still have the ten dimes that George Thomas offered in 1952, for correcting an error. This reward is hereby increased to \$e. It should be e^t but that could grow exponentially. *More important: All suggestions are welcome.* Please write about any part of this subject.

CHAPTER 1

Introduction to Calculus

1.1 Velocity and Distance

The right way to begin a calculus book is with calculus. This chapter will jump directly into the two problems that the subject was invented to solve. You will see what the questions are, and you will see an important part of the answer. There are plenty of good things left for the other chapters, so why not get started?

The book begins with an example that is familiar to everybody who drives a car. It is calculus in action—the driver sees it happening. The example is the relation between the *speedometer* and the *odometer*. One measures the speed (or *velocity*); the other measures the *distance traveled*. We will write v for the velocity, and f for how far the car has gone. The two instruments sit together on the dashboard:

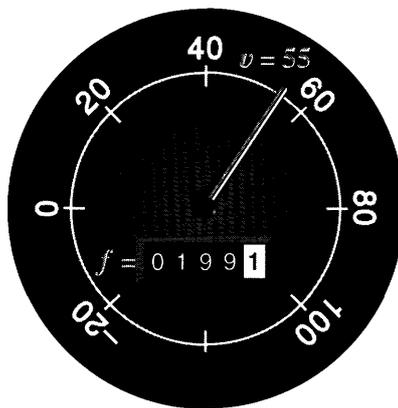


Fig. 1.1 Velocity v and total distance f (at one instant of time).

Notice that the units of measurement are different for v and f . The distance f is measured in kilometers or miles (it is easier to say miles). The velocity v is measured in km/hr or *miles per hour*. A unit of *time* enters the velocity but not the distance. Every formula to compute v from f will have f divided by time.

The central question of calculus is the relation between v and f .