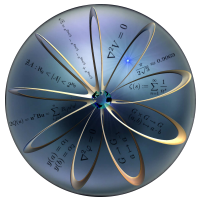

planetmath.org

Math for the people, by the people.

Preface

Canonical name	Preface1
Date of creation	2014-08-03 22:47:47
Last modified on	2014-08-03 22:47:47
Owner	PMBookProject (1000683)
Last modified by	rspuzio (6075)
Numerical id	3
Author	PMBookProject (6075)
Entry type	Definition
Classification	msc 26A06

PREFACE

The significance of the Calculus, the possibility of applying it in other fields, its usefulness, ought to be kept constantly and vividly before the student during his study of the subject, rather than be deferred to an uncertain future.

Not only for students who intend to become engineers, but also for those planning a profound study of other sciences, the usefulness of the Calculus is universally recognized by teachers; it should be consciously realized by the student himself. It is obvious that students interested primarily in mathematics, particularly if they expect to instruct others, should recognize the same fact.

To all these, and even to the student who expects only general culture, the use of certain types of applications tends to make the subject more real and tangible, and offers a basis for an interest that is not artificial. Such an interest is necessary to secure proper attention and to insure any real grasp of the essential ideas.

For this reason, the attempt is made in this book to present as many and as varied applications of the Calculus as it is possible to do without venturing into technical fields whose subject matter is itself unknown and incomprehensible to the student, and without abandoning an orderly presentation of fundamental principles.

The same general tendency has led to the treatment of topics with a view toward bringing out their essential usefulness. Thus the treatment of the logarithmic derivative is vitalized by its presentation as the relative rate of change of a quantity; and it is fundamentally connected with the important " compound interest law," which arises in any phenomenon in the relative rate of increase (logarithmic derivative) is constant.

Another instance of the same tendency is the attempt, in the introduction of the precise concept of curvature, to explain the reason for the adoption of this, as opposed to other simpler but cruder measures of bending. These are only instances, of two typical kinds, of the way in which the effort to bring out the usefulness of the subject has influenced the presentation of even the traditional topics.

Rigorous forms of demonstration are not insisted upon, especially where the precisely rigorous proofs would be beyond the present grasp of the student. Rather the stress is laid upon the student's certain comprehension of that which is done, and his conviction that the results obtained are both rea-

sonable and useful. At the same time, all effort has been made to avoid those grosser errors and actual misstatements of fact which have often offended the teacher in texts otherwise attractive and teachable.

Thus a proof for the formula for differentiating a logarithm is given which lays stress on the very meaning of logarithms; while it is not absolutely rigorous, it is at least just as rigorous as the more traditional proof which makes use of the limit of $(1 + 1/n)^n$ as n becomes infinite, and it is far more convincing and instructive. The proof used for the derivative of the sine of an angle is quite as sound as the more traditional proof (which is also indicated), and makes use of fundamentally useful concrete concepts connected with circular motion. These two proofs again illustrate the tendency to make the subject vivid, tangible, and convincing to the student; this tendency will be found to dominate, in so far as it was found possible, every phase of every topic.

Many traditional theorems are omitted or reduced in importance. In many cases, such theorems are reproduced in exercises, with a sufficient hint to enable the student to master them. Thus Taylor's Theorem in several variables, for which wide applications are not apparent until further study of mathematics and science, is presented in this manner.

On the other hand, many theorems of importance, both from mathematical and scientific grounds, which have been omitted traditionally, are included. Examples of this sort are the brief treatment of simple harmonic motion, the wide application of Cavalieri's theorem and the prismoid formula, other approximation formulas, the theory of least squares (under the head of exercises in maxima and minima), and many other topics.

The Exercises throughout are colored by the views expressed above, to bring out the usefulness of the subject and to give tangible concrete meaning to the concepts involved. Yet formal exercises are not at all avoided, nor is this necessary if the student's interest has been secured through conviction of the usefulness of the topics considered. Far more exercises are stated than should be attempted by any one student. This will lend variety, and will make possible the assignment of different problems to different students and to classes in successive years. It is urged that care be taken in selecting from the exercises, since the lists are graded so that certain groups of exercises prepare the student for other groups which follow; but it is unnecessary that all of any group be assigned, and it is urged that in general less than half be used for any one student. Exercises that involve practical applications and others that involve bits of theory to be worked out by the student are

of frequent occurrence. These should not be avoided, for they are in tune with the spirit of the whole book; great care has been taken to select these exercises to avoid technical concepts strange to the student or proofs that are too difficult.

An effort is made to remove many technical difficulties by the intelligent use of tables. Tables of Integrals and many other useful tables are appended; it is hoped that these will be found usable and helpful.

Parts of the book may be omitted without destroying the essential unity of the whole. Thus the rather complete treatment of Differential Equations (of the more elementary types) can be omitted. Even the chapter on Functions of Several Variables can be omitted, at least except for a few paragraphs, without vital harm; and the same may be said of the chapter on Approximations. The omission of entire chapters, of course, would only be contemplated where the pressure of time is unusual; but many paragraphs may be omitted at the discretion of the teacher.

Although care has been exercised to secure a consistent order of topics, some teachers may desire to alter it; for example, an earlier introduction of transcendental functions and of portions of the chapter on Approximations may be desired, and is entirely feasible. But it is urged that the comparatively early introduction of Integration as a summation process be retained, since this further impresses the usefulness of the subject, and accustoms the student to the ideas of derivative and integral before his attention is diverted by a variety of formal rules.

Purely destructive criticism and abandonment of coherent arrangement are just as dangerous as ultra-conservatism. This book attempts to preserve the essential features of the Calculus, to give the student a thorough training in mathematical reasoning, to create in him a sure mathematical imagination, and to meet fairly the reasonable demand for enlivening and enriching the subject through applications at the expense of purely formal work that contains no essential principle.

E. W. DAVIS,
W. C. BRENKE,
E. R. HEDRICK, Editor.

June, 1912.