

**ELEMENTARY COURSE
IN EXPERIMENTAL
PHYSICS**

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Elementary Course in Experimental Physics by Arthur Chambers Alexander

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ARTHUR CHAMBERS ALEXANDER

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PHYSICS**

AN
ELEMENTARY COURSE
IN
EXPERIMENTAL PHYSICS

BY

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PREFACE.

THIS is not intended to be a complete laboratory manual, or text-book. It simply contains the directions for a series of laboratory exercises in Elementary Physics, representing substantially the first year's work in Experimental Physics at the University of California as given in 1896-7. These directions were originally typewritten and duplicated by means of the mimeograph, a method of preparation that, while allowing the instructor great freedom in modifying and adapting the course to his pupils and the exigencies of the laboratory, also entailed considerable time and labor. As the majority of the exercises will be given during the coming year in their present form, it was deemed best to print the entire course and to modify it, whenever necessary, by supplementary directions. It is not designed to be a course in Physical Measurement, the quantitative feature being retained from necessity and not choice. The primary object of the exercises is to illustrate and impress on the mind of the student the elementary principles of Physics. A course of lectures and recitations with assigned reading and problems is intended to accompany and supplement the work in the laboratory.

In arranging the sequence of exercises an attempt has been made to have those subjects taken up first that are more readily adapted to the laboratory facilities of the secondary schools, and can be easily comprehended by the immature student. In this way, and by giving an annual examination for advanced standing in the subject, it is hoped to induce many of the best equipped preparatory schools to carry their pupils somewhat farther in Physics than is required for admission to the University. The subject of Sound presents peculiar difficulties of presentation to a large class in the laboratory where only one room is available and all are not gifted alike with the sense of musical pitch. As a result, many interesting and instructive laboratory exercises on

this subject had to be omitted, and only two exercises on Sound have been retained in the course.

The author has made a free use of the work of his predecessors, most of these exercises having been adapted from Whiting's "Exercises in Elementary Physics," the text used in the University of California in 1894-5 and 1895-6. The general arrangement and method of presentation is also that of Whiting. This book represents only another step in the development of an elementary laboratory course in Physics. Many of the exercises described have barely passed the tentative stage and there is still much to be done in the way of addition and elimination. It is the intention to further amplify and modify the course, and the author will be glad of suggestions from any one interested.

As it is impracticable to furnish a complete set of apparatus for each exercise to every student, or pair of students, it has been found best to arrange the apparatus for the separate exercises on consecutive tables and to let the students pass from one table to another as the exercises are completed. A laboratory period of two hours and three-quarters is allowed for the performance of an exercise. A division of the subject matter of each exercise has been made, indicated in the text by an extra space and a dash between the lines. Every student is required to complete the first part in order to be credited with the exercise, and he is required to perform as much of the second part as the laboratory period will permit. The students are also required at the close of each laboratory period to leave duplicate copies of their notes with the instructor for correction.

The author has already mentioned the liberal use he has made of Whiting's "Exercises in Elementary Physics." He desires also to express his great indebtedness to the present members of the Department of Physics for the many ways in which they have helped and encouraged him, and for the hearty interest they have taken in the preparation of these exercises.

ARTHUR C. ALEXANDER.

Berkeley, Cal., May 1, 1897.

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COURSE IN EXPERIMENTAL PHYSICS

1. DENSITY.

I (a). Measure the dimensions of a wooden block containing about one cubic decimetre. This can be done within a fraction of a centimetre by laying the block on a metre rod and sighting along its sides. Each dimension should be measured on four sides and the results averaged.

Calculate the volume of the block in cubic centimetres.

(b.) What is the relation between mass and weight? Explain how the mass of a body can be found by weighing it. Weigh the wooden block on a simple form of balance (a Fairbank's "trip scales"), and determine its mass to 0.1 gm. In weighing, always tap the balance and observe whether the arms swing the same distance on both sides of the horizontal position, and do not wait for them to come to rest.

Calculate the density of the block, using four significant figures, in gm. per c. c., and in lbs. per cu. ft., allowing 453.6 gm. to a pound and 28,316 c. c. to a cu. ft.

II (a). Measure the interior dimensions of an open cube, or mold, holding about a liter, and calculate its cubical contents.

(b.) After placing the mould on the balance and counterbalancing it carefully with shot, fill it with water, and find the