AN ELEMENTARY TEXT-BOOK OF MECHANICS (KINEMATICS AND DYNAMICS)

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649053698

An Elementary Text-Book of Mechanics (Kinematics and Dynamics) by J. J. Doherty

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

J. J. DOHERTY

AN ELEMENTARY TEXT-BOOK OF MECHANICS (KINEMATICS AND DYNAMICS)

Trieste

PREFACE.

THIS book contains the principles of the sciences of Motion and Force. These sciences were formerly treated of under the title *Mechanics*; but in recent works the name of *Kinematics* is given to the science of motion, and *Dynamics* to that of force.

Since the publication of Professors Thomson and Tait's *Natural Philosophy*, and of Tait's *Recent Advances in Physical Science*, it has been generally acknowledged that the true foundation of the science of Dynamics is the Laws of Motion, as stated by Newton. Availing myself of these works, and guided to some extent by the course followed in recent examination papers, I have attempted, with the aid of elementary mathematics only, to give in the following pages the statement and demonstration of the principles of Kinematics and Dynamics. A chapter is devoted to each of the Laws of Motion, which are explained at length and illustrated by examples. From these laws the propositions relating to forces in equilibrium follow at once as corollaries; and thus the laboured though ingenious proofs from first principles of the fundamental proposition of Statics—such as Duchayla's—are rendered unnecessary.

The subjects treated of in these pages afford an excellent opportunity to the student for the applica-

tion of the abstract principles of geometry and algebra, which he has learned. For this reason alone they deserve a place in the curriculum even of elementary schools. As a means of mental culture they are not inferior to the pure mathematics; and throughout the work I have aimed at making their study an intellectual training.

Numerous exercises of a varied character are appended to each chapter. They are intended to illustrate the subjects of the chapter, and they can all be solved by the principles explained in the text. Typical problems under each chapter have been worked as examples of the methods that the students may apply to the others. Hints for the solution of all the remaining exercises are appended to the work. In these hints such help is afforded as a teacher would give to his pupils; and thus where the aid of a teacher cannot be obtained, an intelligent student who has read the text may work through all the problems without the assistance of a master.

A great many of the exercises have been selected from the Examination Papers of the Universities of London, Cambridge, Edinburgh, and Dublin, from the Woolwich Entrance Examination Papers, and from the Papers set to candidates at examinations held by the Science and Art Department, and by the National Board of Education, Ireland. Many of the questions, however, are original, and have been specially prepared to illustrate the demonstrations of the text.

The subjects have not been treated in accordance

with the programme for any particular examination. As, however, the work is designed as a text-book for use in schools, and for students who are preparing for examinations, care has been taken to include all important principles and demonstrations usually given in elementary works on Mechanics.

The articles and chapters marked thus [*] are somewhat more difficult than the others. They are given in their proper places in the text, but they may be omitted on a first reading of the work.

J. J. D.

DUBLIN,
May, 1881.

PREFACE TO THE SECOND EDITION.

SOME errors in the exercises and answers of the First Edition of this work have been corrected in the present edition.

April, 1882.

CONTENTS.

Chapter		Page
I.	Introductory,	1
	KINEMATICS.	
II.	Relations between Space, Time, and Velocity,	2
III.	Composition and Resolution of Velocities and Accelerations,	16
	DYNAMICS—KINETICS.	
IV.	First Law of Motion. Composition of Uniform and Accelerated Velocities in the same direction,	28
V.	Projectiles. Composition of Uniform and Accelerated Velocities in different directions,	41
VI.	Second Law of Motion. Relations between Force, Mass, and Acceleration,	52
VII.	Third Law of Motion. Reactions. General remarks on Laws of Motion,	67
VIII.	Impact or Collision of Bodies,	76
IX.	Work and Energy,	86
X.	Motion in a circular path with uniform velocity,	99
XI.	Motion in a circular arc with variable velocity,	106
	DYNAMICS—STATICS.	
XII.	Composition and Resolution of Forces acting on a Particle,	116
XIII.	Parallel Forces,	129
XIV.	Moments of Forces,	136
XV.	Centre of Parallel Forces,	148
	KINETICS AND STATICS.	
XVI.	Machines,	168
XVII.	Friction,	175
	Hints for the Solution of the Exercises,	210
	Answers,	218

CHAPTER I.

INTRODUCTORY.

THE laws of the material universe form the subject of Natural Philosophy.

There appear to be five fundamental conceptions to which all our ideas of this universe may be referred. They are those of *Time*, *Space*, *Motion*, *Force*, and *Matter*.

TIME AND SPACE.—*Algebra* has been called the science of pure Time, and *Geometry* the science of pure Space. With these sciences we shall not be directly concerned; but we shall make use of their results and their methods.

A measure of time is supplied to all mankind by the revolution of the earth on its axis; and a *second*, which is the 86,400th part of the mean solar day, is the unit of time that is ordinarily employed.

There is no such natural measure of space, and hence different nations make use of different and arbitrary units of space. In this country the scientific unit of length generally adopted is the *foot*, which is one-third of the *standard yard*. The standard yard is defined by Act of Parliament to be the distance between the centres of the transverse lines in the two gold plugs in the bronze bar deposited in the Exchequer, the temperature being 62° Fah.

The French standard of length is the *metre*. It is nearly equal to 39·37 British inches. The 100th part of the metre is the *centimetre*.

Units of surface and volume are derived from the units of length.

MOTION.—The science which treats of Motion, without considering the causes which produce it or the quantity of matter moved, has obtained the name of *Kinematics*.