

**QUESTIONS AND  
EXERCISES ON  
STEWART'S LESSONS  
IN ELEMENTARY PHYSICS**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649685516

Questions and Exercises on Stewart's Lessons in Elementary Physics by George A. Hill

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**GEORGE A. HILL**

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ON  
STEWART'S LESSONS  
IN  
ELEMENTARY PHYSICS.

BY

GEORGE A. HILL,

ASSISTANT PROFESSOR OF PHYSICS IN HARVARD UNIVERSITY.

WITH ANSWERS AND OCCASIONAL SOLUTIONS.

BOSTON:  
GINN AND HEATH.  
1880.

QC 21  
S 84 H 5

TO VNU  
ASSOCIATION

Entered according to Act of Congress, in the year 1874,  
BY GINN BROTHERS,  
in the Office of the Librarian of Congress, at Washington.

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C. L. Cony,

## PREFACE.

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THE following pages have been drawn up with the aim of making Mr. Stewart's excellent work more useful in elementary teaching.

Part I. consists of questions upon the text of Mr. Stewart's book which are intended to be direct and exhaustive. Opinions differ as to the value of such questions. No doubt a thoroughly competent teacher will ask questions in his own way with the best effect; but unfortunately such teachers, at least in scientific subjects, are not numerous. In all cases the questions will be found useful for review and examination purposes.

Parts II. and III., which form the principal part of the work, have been written with two objects in view. First, to stimulate original thought on the part of the student, and to give the teacher the means of testing thoroughly the student's knowledge of principles. Secondly, to make certain needful additions to the felicitous but cursory sketch of Mechanics, Hydrostatics, and Pneumatics, contained in the first two chapters of Mr. Stewart's book.

Molecular Physics is rapidly assuming the character of an exact science; and in proportion as this takes place, the importance of a good knowledge of the general laws of Motion and Force, and of the ability to reason deductively, increases. Nothing can give training in deduction better than the study of Rational Mechanics. Training in the methods of induction, which is so large a part of scientific culture, cannot, in

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our judgment, be imparted successfully by the study of text-books; the place to receive it is in Physical Laboratories, which are happily becoming more and more common, or by observation and reflection in the vast Laboratory of Nature around us. The chief value, which the text-book study of Physics can be made to have, consists in disciplining the mind in scientific demonstration of the deductive kind.

The Exercises are divided into two classes, as explained on page 69. A few of them are original; the most have been selected from English works. Few of them require much numerical work, and many of them none at all.

In preparing the Solutions, the author has been under obligations to the elementary writings of Professors Thomson, Tait, and Maxwell.

It was found impossible to prepare solutions of the more difficult Exercises in small type in season for the present edition. In working out these Exercises, where aid is found necessary it should be obtained, if possible, from a competent teacher. The student is also strongly advised to consult special works which treat of the subjects covered by the Exercises. By doing this, the student will not merely find the aid which he desires, — he will be acquiring a habit of mind which is characteristic of the cultivated man and of all productive scholarship, the habit of consulting and carefully comparing the views which different minds take of the same subject, and of that originality in thought which comes from an independent use of many authorities. On page 69 will be found a list of elementary works which may be consulted with advantage.

G. A. HILL.

CAMBRIDGE, August 25, 1874.



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## PART I.

### QUESTIONS ON STEWART'S ELEMENTARY PHYSICS.

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#### *Introduction.*

1. How do we become aware of the existence of objects outside of ourselves ?
2. What is the ground of our expectation that the sun will rise to-morrow ? In general, when is our expectation that a certain phenomenon will recur well grounded ?
3. What are characteristics of the knowledge of physical laws which men acquire from every-day experience ?
4. How long since men first set themselves systematically to the task of acquiring a knowledge of the laws of nature ?
5. What is the object of Physics ?
6. What do we learn from astronomy concerning the magnitude of the Universe ?
7. Explain the three-fold division of matter into *substances*, *molecules*, and *atoms*. Illustrate by a familiar example.
8. What is the analogous three-fold division in astronomy ?
9. What resemblance exists between the structure of the Universe and that of a body on the earth's surface, in consequence of which both may be called *porous* ?
10. Distinguish between physical and sensible pores. What proves the existence of physical pores ? Give instances of bodies having sensible pores.