

# **1000 EXERCISES IN PHYSICS**

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1000 Exercises in Physics by A. P. Gage

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# EXERCISES IN PHYSICS.

BY

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## PREFACE.

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THE aim of these Exercises is to render assistance to the general teacher in preparing for his daily work ; to the inexperienced teacher, by suggesting the turn which his instruction should take ; to the pupil, by enabling him to make a careful self-examination of his attainments. He who interprets the last statement as being an encouragement to cramming, must, to be consistent, object to all questions, whether oral or written, whether by teachers or by authors. By placing copies in the hands of his pupils *after* the different branches of physics have been thoroughly discussed in the laboratory and classroom, noting such questions as he would have them ponder, and encouraging them to extend their information beyond the limits of their prescribed text-book, the author expects these Exercises to become a valuable auxiliary in his instruction.

Inquiries have been pushed into the field of speculative science, so that the pupil may catch a glimpse of the future physics as described by Rowland, Thomson, Maxwell, and others ; and a view of these things, hurried though it be, will, it is hoped, awaken in him a desire to peer more deeply into the mysteries of nature.

The author hopes that errors in the following pages will be treated with leniency ; and, on the ground of being a much-employed teacher, begs to be excused from answering questions upon the subject-matter, — the usual penalty for preparing a book.



## EXERCISES IN PHYSICS.

## INTRODUCTORY EXERCISES.

1. What is the etymological meaning of the term *physics*?
2. What is natural science?
3. When does one's knowledge of science begin? "When he can measure what he is speaking about, and express it in numbers."  
— *Thomson*.
4. To whom do we owe all the great advances in knowledge? "To those who endeavor to find *how much* there is of anything." — *Maxwell*.
5. How do we measure a quantity? By finding how many times a certain definite quantity of the same kind as the quantity to be measured, called a unit, is contained in the quantity to be measured.
6. How is a physical quantity expressed? By a phrase consisting of two parts; viz., a numerical and a denominational, the latter being the name of the thing of the same kind as the quantity to be expressed, and of a certain magnitude agreed upon among men as a standard unit.
7. What is an hypothesis? A provisional assumption of facts.
8. What is a theory? It is an explanation of the hidden cause of certain effects that are evident to the senses.
9. What is a body? Any limited portion of matter.
10. Which of the following terms are applicable to substances, and which to bodies of matter; viz., desk, rod, iron, wood, water, lake, tumbler of water, crayon, chalk, glass, tumbler, air, the air in the room, iceberg, ice, earth, the earth?
11. In what two ways may physics be taught? Inductively and deductively.
12. What is a natural law? An expression of the relation between certain physical quantities, or of the order in which the causes and effects of natural phenomena follow one another.



13. What is the kinetic theory of matter? It assumes that all the properties of matter are merely attributes of motion.

14. What is a phenomenon? A change resulting from the mutual action of bodies.

15. What name is given to the process of reasoning by which, having acquired facts by observation and experiment, we discover how they are related; in other words, by which natural laws are discovered? Induction.

16. A tumbler when full of water is capable of receiving many tumblers full of certain gases. Is water impenetrable? Explain.

17. *Quantity of matter* in a body is expressed briefly by what word?

18. A gram of water occupies what space?

19. The quantity of matter per unit of space is expressed by what word?

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#### FORCE.

20. How do you know that force exists?

21. What is the physical cause of motion?

22. Is a force always doing something?

23. What is the most universal force known?

24. Is friction a force? [See Daniell's Text-Book on the Principles of Physics, p. 162.]

25. What is meant by the statement that a force acts in a certain direction, *e.g.* toward the north? Would there be any difference in its effect on the body whether the force were a pulling or a pushing force acting in the same direction?

26. Show that force is but a partial aspect of a stress.

27. How is force measured when it does not produce motion? Give an example.

28. Criticise the following statement: "The tendency of force is generally to produce motion."

29. What prevents the attractive force between the molecules of a body from bringing them in contact with one another?

30. How does the tension of a string compare with the force applied at either end?

31. If the force at each end is not the same, what will happen?

32. Show that the tension of a string pulled with a force of three at each end is three, and not six, as supposed by some.

33. Explain how attraction between a drop of water and the end of a finger, being insensible when at a sensible distance, becomes at an insensible distance sufficient to support the drop.

34. So far as cohesion is concerned, is it necessary to assume the existence of any other force than that of gravity, or any other law than the Newtonian? No; so says Sir William Thomson.

35. A string supports a weight of 4 lbs. at its lower end, a weight of 6 lbs. above the first, and a weight of 5 lbs. above the second. Find the tensions of the three parts of the string.

36. What effect does an unbalanced force acting on a body always produce?

37. Let an unbalanced force of 8 lbs. act for five minutes on each of two bodies, one having a mass of 10 lbs., the other a mass of 100 lbs. In which will it produce the greater change of momentum?

38. You stand on the earth and hold an apple in your hand. Show that as long as you hold the apple the gravitation stress between the apple and your hand can produce no change of momentum either in the apple or the earth.

39. Show that as soon as you cease to support the apple an equal change of momentum will occur in both the apple and the earth.

40. A gun weighing 20 tons is suspended by a cable so as to be free to swing like a pendulum. A shell weighing 10 lbs. is projected from the gun, and its maximum velocity is 800 yds. per second. What is the maximum velocity of the gun's rebound?

41. A loaded block of wood weighing 100 lbs. is suspended so as to swing freely. A cannon-ball weighing 10 lbs. is thrown into the wood, causing the block to move with a velocity of 10 ft. per second. Suppose that none of the mechanical energy of the ball is wasted in heat, etc., what was the velocity of the ball? 1010 ft. per sec.

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### GRAVITATION.

42. Who discovered that heaviness is due to action at a distance between two portions of matter? Sir Isaac Newton.

43. What is the best way of defining gravitation? Let a stone drop.

44. How does the force of gravity differ from other forces?
45. Distinguish between *weight* and *mass*.
46. Under what circumstances will the weight of a body vary, though its mass remains the same?
47. State some well-known phenomena which are positive evidence of gravitation stress between the sun and the earth.
48. State two things on which the weight of a body depends.
49. Is there any truth in the legend that Newton was led to the discovery of the laws of gravitation on seeing an apple fall from a tree in his garden? Nothing could be farther from the truth.
50. If a body weighs 8 lbs., does it follow that its mass is 8 lbs.?
51. Describe some form of dynamometer with which you are acquainted, and state whether it is capable of measuring a push or a pull.
52. The stress, called *gravity*, between the sun and the earth at different parts of the latter's orbit is proportional to what?
53. Show the importance of distinguishing in physics between mass and weight.
54. On what conditions would the force of gravity be the same on all parts of the earth's surface?
55. If a cubical vessel filled with water were placed at rest in a hollow space at the centre of gravity of the earth, and the vessel should suddenly be annihilated, what would happen to the liquid?
56. What is meant by the statement that a body weighs 10 lbs.?
57. A body 4000 miles above the earth's surface weighs 4 lbs.; what is its mass?
58. How many fold must the distance between the centers of gravity of two bodies be increased in order that the gravitation stress between them become one-third?
59. Show that if the earth's density were doubled, the weight of every body on its surface would be doubled.
60. At what latitude has a body its greatest weight at sea-level?
61. State two reasons why the force of gravity is greater in Montreal than in New Orleans.
62. Give two reasons why weight varies with latitude.
63. Why is the weight of a body at the equator less than the force of gravity at the same place?
64. If you let drop at the same instant a 5-cent nickel and a circular piece of paper of the same diameter, which will reach the earth