物理(上册)

林书隆 著

重庆出版社

需要全本请访问 www.ertongbook.com

图书在版编目(CIP)数据

物理. 上册/林书隆著. —重庆:重庆出版社,2005.4
ISBN 7-5366-6627-6

Ⅰ. **物**… Ⅱ. **林**… Ⅲ. **物理课—中学—课外读物—英文** Ⅳ. C634.73

中国版本图书馆 CIP **数据核字(**2004**)第** 134873 **号**

▲ **物 理(上册)**
林书隆 著

特邀编辑 梁 炫
责任编辑 江 萍
封面设计 邵大维
技术设计 寇小平

重庆出版社出版、发行
(重庆长江二路 205 **号 邮政编码** 400016**)**
新华书店经销
内江新华印务有限公司印刷

开本 787×1092 1/16 **印张** 12.75
字数 327 **千** **插页** 1
2005 **年** 4 **月第** 1 **版**
2005 **年** 4 **月第** 1 **版第** 1 **次印刷**

ISBN 7-5366-6627-6/G·2292
定价:22.00 **元**

鸣　　谢

承　　蒙

南昌大学教授　　林俊伯

北京大学教授　　林荣生

南昌大学教授　　陈福生

重庆教育学院教授　文宇庄

指导和帮助，深表谢意。

Acknowledgement

I am very grateful to Professor Lin Junbo at Nanchang University, Professor Lin Rongsheng at Beijing University, Professor Chen Fusheng at Nanchang University, and Professor Wen Yuzhuang at Chongqing Education College for their guidance and help.

林书隆

Foreword

The present volume is a popular English reader on physics. It is intended principally for senior middle-school students, although it can also be for reference of college students and adults. After working thoroughly through the two books, of which this is the first, the student should master not only physics knowledge of senior middle school, but also informal English. In the course seemed to be difficult you will see the familiar physics terms, texts and common structures and sentence patterns of the language. The first book of the two introduces Newton's mechanics. The second involves heat, electromagnetism, optics and atomic physics. The glossary with Chinese translation will be found at the end of each book.

It is unavoidable that there is still some inadequacy in the book for the limitation of my knowledge. I am very glad to receive comments and suggestions from users of the course, and a sincere thanks will be due to them.

Lin Shulong

前　言

本书是通俗英语物理读物。该书主要面向高中学生，也可供大学生和成年人参考。通过这两本书的学习，这是其中的上册，学生不但可以掌握高中物理知识，还可以掌握日常英语。在这似乎困难的课程里，你会见到熟悉的物理术语，课文和英语常见结构和句型。本书上册介绍牛顿力学，下册包括热学、电磁学、光学和原子物理学。附有中文的术语汇编可以在每本书末查到。

由于本人知识有限，书中不足之处在所难免。本人非常乐意接受读者的意见和建议，并向他们致以诚挚的谢意。

林书隆

需要全本请访问 www.ertongbook.com

Preface

When studying this course, do you know what physics is and why physics is important?

Physics is a natural science investigating structures and laws of motion of matter as small as subatomic particles and as large as the universe. Much scientific work is done in groups in which people collaborate with one another. Great achievements in physics lead to the development of devices such as VCDs, DVDs, HDTVs. Communication systems, computers and new materials improve our living conditions.

The first computer in the world, ENIAC computer, built in 1946, weighed 30 tons. Today an efficient personal computer composed of integrated circuits can be placed on a desk in your home.

China launched an intercontinental ballistic missile in 1980, which flew about nine thousand km and hit accurately the aim.

In 1984, our synchronous comsat was sent up successfully. Its orbital altitude above the surface of the Earth was more than 36000 kilometers.

China's first manned spaceship, the Shenzhou (Divine Vessel) Ⅴ, blasted off from the Jiuquan Satellitelaunch Center in Gansu Province, at 9, a. m. on Oct. 15, 2003. The spaceship atop a Long March Ⅱ F rocket, was piloted by Yang Liwei, a lieutenant colonel of the People's Liberation Army. After orbiting the Earth 14 times, China's first manned spaceship safely returned to the Earth. At 6 28, Beijing time, on Oct. 16, 2003, China's first taikonaut successfully touched down in the designated place in the Inner Mongolia Autonomous Region. The re-entry capsule of Shenzhou Ⅴ was found. The Chinese manned spaceflight program won tremendous successes.

Super computer Shenwei developed in China is capable of 3.84×10^{11} calculations per second.

Chinese outstanding scientist Li Sze-kwang originated geomechanics. Applying the theory and methods of geomechanics, after hard work at geological, physical, and drilling exploration, Chinese workers discovered Taching oil field in 1959. From then on, Shengli, Takang and other oil fields were discovered one after another.

The researching on nuclear physics resulted in generating new power source. At the

end of the 20th century, Qinshan and Dayawan nuclear power stations were built in the mainland of China. Chinese people have entered on a new era applying nuclear energy.

It became general knowledge that the all-weather multi-purpose Feibao fighter-bomber Chinese designed and built is superior to some aircrafts, such as F-16 and F-15 in U. S. Air Force before the Lockheed F-22 is operational.

Science and technology constantly interact. Physics is an important basis of modern technology, and propels human society forward. The results and methods of physics have penetrated chemistry, biology, astronomy, geology, meteorology and so on.

Adopting a scientific method is helpful to you. The method of systematic experiment, observation and analysis is known as the scientific method. Understanding, remembering, applying and discussing physics knowledge will interest you.

First book 简明目录

力　　学

第一章　物理量的测量 …… (2)

实验　使用游标卡尺 …… (5)

第二章　直线运动 …… (7)

实验　测量加速度 …… (31)

第三章　力 …… (33)

实验　验证平行四边形法则 …… (47)

第四章　牛顿运动定律 …… (50)

第五章　物体的平衡 …… (70)

第六章　曲线运动 …… (82)

实验　研究平抛运动 …… (107)

第七章　万有引力 …… (108)

第八章　动量和动量守恒 …… (120)

实验　验证动量守恒定律 …… (134)

第九章　机械能 …… (137)

第十章　机械振动 …… (160)

实验　用单摆测量重力加速度 …… (178)

物理术语(附中文) …… (182)

Contents

Foreword …… (1)
Preface …… (1)
Mechanics …… (1)
Chapter 1 The Measure of Physical Quantities …… (2)
1.1 Scientific Notation …… (2)
1.2 The Measure of Length …… (3)
1.3 Using Vernier Calipers …… (4)
Physics Lab :Take Measurement with a Vernier Caliper …… (5)
Chapter 1 Review …… (6)
Chapter 2 Rectilinear Motion …… (7)
2.1 Mechanical Motion …… (7)
Practice Problems 1 …… (9)
2.2 The Relationship between Displacement and Time …… (11)
Practice Problems 2 …… (12)
2.3 Describing Moving Rate Velocity …… (13)
Practice Problems 3 …… (15)
2.4 The Relationship between Velocity and Time …… (15)
Practice Problems 4 …… (17)
2.5 Acceleration …… (18)
Practice Problems 5 …… (19)
2.6 The Laws of Uniform Variable Rectilinear Motion …… (19)
Practice Problems 6 …… (21)
2.7 Using the Laws of Uniform Variable Rectilinear Motion …… (21)
Practice Problems 7 …… (23)
2.8 Freely Falling Object's Motion …… (24)
Practice Problems 8 …… (26)
Chapter 2 Review …… (26)
Problems …… (28)
How It Works …… (30)
Physics Lab :Using Spark Timer to Measure an Acceleration of a Uniform Variable Rectilinear Motion …… (31)

Chapter 3 Forces …… (33)
3.1 Forces …… (33)
3.2 Weight Force …… (34)
Practice Problems 1 …… (35)
3.3 Spring Force …… (35)
Practice Problems 2 …… (37)
3.4 Friction Force …… (38)
Practice Problems 3 …… (40)
3.5 Compounding Forces …… (41)
Practice Problems 4 …… (42)
3.6 Resolving Force …… (43)
Practice Problems 5 …… (44)
Chapter 3 Review …… (45)
Reading Material :Air Drag …… (47)
Physics Lab :Verifying the Rule of Parallelogram of Forces …… (47)
Problems …… (48)
Chapter 4 Newton's Laws of Motion …… (50)
4.1 Newton's First Law of Motion …… (50)
Practice Problems 1 …… (52)
4.2 Changing the State of Motion of Objects …… (52)
4.3 Newton's Second Law of Motion …… (53)
Practice Problems 2 …… (56)
4.4 Newton's Third Law of Motion …… (57)
Practice Problems 3 …… (58)
4.5 The System of Mechanics Units …… (59)
Practice Problems 4 …… (61)
4.6 Using Newton's Laws …… (61)
Practice Problems 5 …… (63)
4.7 Apparent Weight …… (63)
Practice Problems 6 …… (64)
4.8 The Realm of Newton's Laws of Motion …… (65)
Chapter 4 Review …… (67)
Problems …… (68)
Chapter 5 Equilibrium of Objects …… (70)
5.1 Equilibrium of an Object Acting Concurrent Forces …… (70)

5.2 Applications of Linear Equilibrium Condition …… (71)
Practice Problems 1 …… (73)
5.3 The Equilibrium of Rotational Body on Fixed Axis …… (73)
5.4 Using the Rotational Equilibrium Condition …… (75)
Practice Problems 2 …… (77)
Reading Material :The Types of Equilibrium Stability …… (78)
Chapter 5 Review …… (80)
Problems …… (81)
Chapter 6 Curvilinear Motion …… (82)
6.1 Curvilinear Motion …… (82)
Practice Problems 1 …… (84)
6.2 Compounding and Decomposing Motions …… (85)
Practice Problems 2 …… (87)
6.3 Projectile Launched Horizontally Motion …… (88)
Practice Problems 3 …… (91)
6.4 Circular Motion with Constant Speed …… (92)
Practice Problems 4 …… (94)
6.5 Centripetal Force and Acceleration …… (95)
Practice Problems 5 …… (97)
Reading Material :Deducing the Equation of Centripetal Acceleration … (98)
6.6 Analysing Practice Examples in Uniform Circular Motion …… (99)
Practice Problems 6 …… (101)
6.7 Centrifugal Phenomenon and Its Application …… (101)
Chapter 6 Review …… (104)
Problems …… (105)
Physics Lab :Studying Projectile Launched Horizontally Motion …… (107)
Chapter 7 Universal Gravitation …… (108)
7.1 The Planetary Motion …… (108)
7.2 The Law of Universal Gravitation …… (109)
7.3 Measuring Gravitational Constant …… (111)
Practice Problems 1 …… (112)
7.4 Using the Law of Universal Gravitation in Astronomy …… (113)
7.5 Artificial Earth Satellites and Cosmic Velocity …… (114)
Practice Problems 2 …… (115)
7.6 Two Kinds of Mass …… (116)

需要全本请访问 www.ertongbook.com

Chapter 7 Review …… (117)
Problems …… (118)
Chapter 8 Momentum and Its Conservation …… (120)
8.1 Impulse and Momentum …… (120)
Practice Problems 1 …… (122)
8.2 Momentum Theorem …… (122)
Practice Problems 2 …… (124)
8.3 The Law of Conservation of Momentum …… (125)
Practice Problems 3 …… (127)
8.4 Using the Law of Conservation of Momentum …… (128)
Practice Problems 4 …… (130)
8.5 Recoil Motion and Rocket …… (131)
Chapter 8 Review …… (133)
Problems …… (133)
Physics Lab :Verifying the Law of Conservation of Momentum …… (134)
Chapter 9 Mechanical Energy …… (137)
9.1 Work …… (137)
Practice Problems 1 …… (140)
9.2 Power …… (140)
Practice Problems 2 …… (142)
9.3 Work and Energy …… (142)
9.4 Kinetic Energy and Work-Energy Theorem …… (143)
Practice Problems 3 …… (146)
9.5 Gravitational Potential Energy …… (147)
Practice Problems 4 …… (149)
9.6 Law of Conservation of Mechanical Energy …… (150)
Practice Problems 5 …… (152)
9.7 Applying Law of Conservation of Mechanical Energy …… (152)
Practice Problems 6 …… (154)
Chapter 9 Review …… (155)
Problems …… (157)
Physics Lab :Verifying Law of Conservation of Mechanical Energy …… (158)
Chapter 10 Mechanical Vibration …… (160)
10.1 Simple Harmonic Motion …… (160)
Practice Problems 1 …… (162)

10.2 Amplitude Period and Frequency …… (163)
Practice Problems 2 …… (164)
10.3 Graph of Simple Harmonic Motion …… (164)
Practice Problems 3 …… (166)
10.4 The Simple Pendulum …… (167)
Practice Problems 4 …… (169)
10.5 Energy of Simple Harmonic Motion Damped Vibration …… (170)
Practice Problems 5 …… (171)
10.6 Forced Vibration Resonance …… (172)
Practice Problems 6 …… (175)
Chapter 10 Review …… (176)
Problems …… (177)
Physics Lab: Using a Simple Pendulum to Measure the Acceleration due to Gravity …… (178)
Appendix Ⅰ: SI Base Units …… (180)
Appendix Ⅱ: SI Derived Units …… (181)
Appendix Ⅲ: Glossary …… (182)

Mechanics

Now we'll first study the knowledge of mechanics, which principally answers what the relationship between force and motion is. Mechanics is the foundation of physics. It is highly important for you to study mechanics well. Only thus, your later work will be laid on solid ground.

The basic laws for mechanics are Newton's laws of motion. We learn the initial knowledge about motion and force prior to investigate Newton's laws of motion. Based on previous theory, furthermore, some essential concepts, such as momentum and mechanical energy, and corresponding laws will be discussed.

However, physics is an experimental science. Whether the result is true or not can be determined by means of experiments. The student who strives successfully to develop experimental techniques will be rewarded both by success in the laboratory as well as by preparation for future advanced scientific and technical work. The measurement of length is of fundamental importance in physical experiments; hence, it fits to serve as the beginning of our course.

Chapter 1 The Measure of Physical Quantities

1.1 Scientific Notation

We should make the measurement when we do physical experiments, and adopt SI units. For example, the SI base units of length, time and mass are the meter, the second, and the kilogram respectively. We got numerical values to represent the results of the measurement.

But the radius of a tungsten atom is about 2/1 000 000 000 meters, and the orbit of Halley 's Comet is approximately 2 700 000 000 000 meters. These numbers are very large or very small, and take up much space, and difficult to read. It 's awkward to use in calculations.

To represent such numbers, write them in scientific notation by expressing decimal places as powers of ten. The numerical part of a quantity is written as a number between 1 and 10 multiplied by a whole-number power of 10.

$$A \times 10^{B}$$

$1 \leqslant A < 10$, and B is an integer. You write numbers in scientific notation, moving the decimal point only one non zero digit remains on the left, then count the number of places you moved the decimal point and use this number as the exponent of 10.

The mean distance from the Earth to the sun is 150000000000 meters. In scientific notation, the distance would be 1.5×10^{11} m. The number of places you move the decimal to the left is expressed as a positive exponent of 10.

The mass of a proton is about 0.000 000 000 000 000 000 000 001 673kg.

Let's move the decimal point 27 places to the right, write the mass of a proton as 1.673×10^{-27}kg. The number of places moved the decimal to the right is expressed as a negative exponent of 10.

If you need to add or subtract measurements expressed in scientific notation, $A \times 10^{B}$, the measurements must be expressed in the same powers of 10 and the same units.

To multiply quantities written in scientific notation, first simply multiply the values and units of A. Then add the exponents of B. To divide quantities expressed in scientific

notation, first divide the values and units of A. Then subtract the exponent of divisor from the exponent of the dividend, if one unit is a multiple of the other, convert to the same unit.

1.2 The Measure of Length

You measure the length of a plastic strip with meter stick, shown in Figure 1-1. The smallest division on the meter stick is a 1mm. You can directly read the scale to the nearest 1mm and then estimate any remaining length as a fraction of 1mm. The plastic strip in the figure is longer than 2.4cm but shorter than 2.5 cm. Looking closely at the scale, you can see that the end of the strip is about three tenths of the way between 2.4cm and 2.5cm.

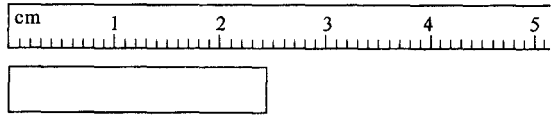


Figure 1-1

The length of the strip is best stated as 2.43cm. The last digit is an estimate. The measurement 2.43cm, contains three valid digits. The first two digits you are sure of, 2 and 4, and the third digit 3, that you made an estimate. The approximate digits with an uncertain digit in a measurement are called the significant digits. If you were to measure the strip with a vernier calipers, you might find it to be 2.434cm long. But the last digit given for any measurement is the uncertain digit.

How do you determine the number of significant digits?

1. All nonzero digits in a measurement are significant .
2. All final zeros after the decimal point are significant.
3. Zeros used solely as placeholders are not significant.

The measurement 35600m, if the five digits are not all significant, can be written in scientific notation, for example, 3.56×10^4 m, represents three significant digits, and 3.560×10^4 m represents four significant digits.

The difference between measurement and real values is known as error. System errors and accidental errors exist in the measurements. To reduce errors of the measurement depends on the instrument used, and the observer, and the experimental principle. Physics is an experimental science. When you perform arithmetic operations, you must note that the result can never be more precise than the least precise

measurement.

For example, Add 10.628m + 5.247m + 6.51m

Note that 6.51m has the least number of decimal places, two decimals,

calculations:

$$\begin{array}{r} 10.628\,\text{m} \\ 5.247\,\text{m} \\ +\ 6.51\ \text{m} \\ \hline 22.385\,\text{m} \end{array}$$

Round off 22.385m to two decimals, the correct answer is 22.39m.

After performing multiplication and division, note the factor with the least number of significant digits. Round the product and quotient to this number of digits.

For example a. Multiply 4.25m by 3.7m

b. Divide 72.7m by 8.703s

calculate these answer

a.

$$\begin{array}{r} 4.25\ \text{m} \\ \times\ \ 3.7\ \text{m} \\ \hline 2\,9\,7\,5 \\ 1\,2\,7\,5 \\ \hline 1\,5.7\,2\,5\ \ \text{m}^2 \end{array}$$

The factor 3.7m, contains two significant digits, state the product in two significant digits. The correct answer is 16 m^2.

b. $$\frac{72.7\text{m}}{8.703\text{s}} = 8.353\text{m/s}$$

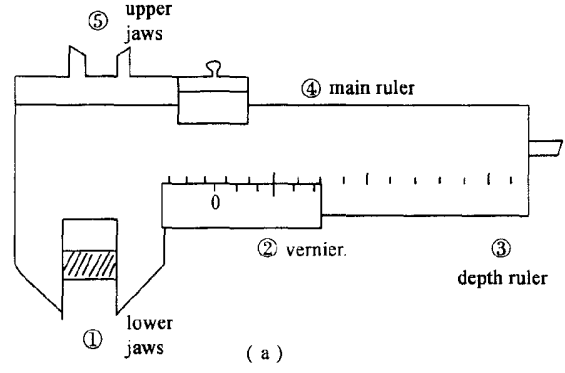
The less precise factor 72.7m contains three significant digits, state the quotient in three significant digits, 8.35m/s is the correct answer.

Much of the values of the measurements in this book will have three significant figures, but few data may contain four or even five significant figures if necessary.

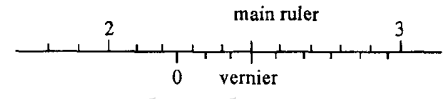
1.3 Using Vernier Calipers

We can more precisely make the measurement of length using vernier calipers than using meter stick.

① Place a section of a metal tube



(a)



(b)

需要全本请访问 www.ertongbook.com