出国留学考试用书

BARRON'S SAT II物理

Subject Test Physics

（第10版）

[美]格维尔茨（Herman Gewirtz），[美]沃尔夫（Jonathan S, Wolf）编著

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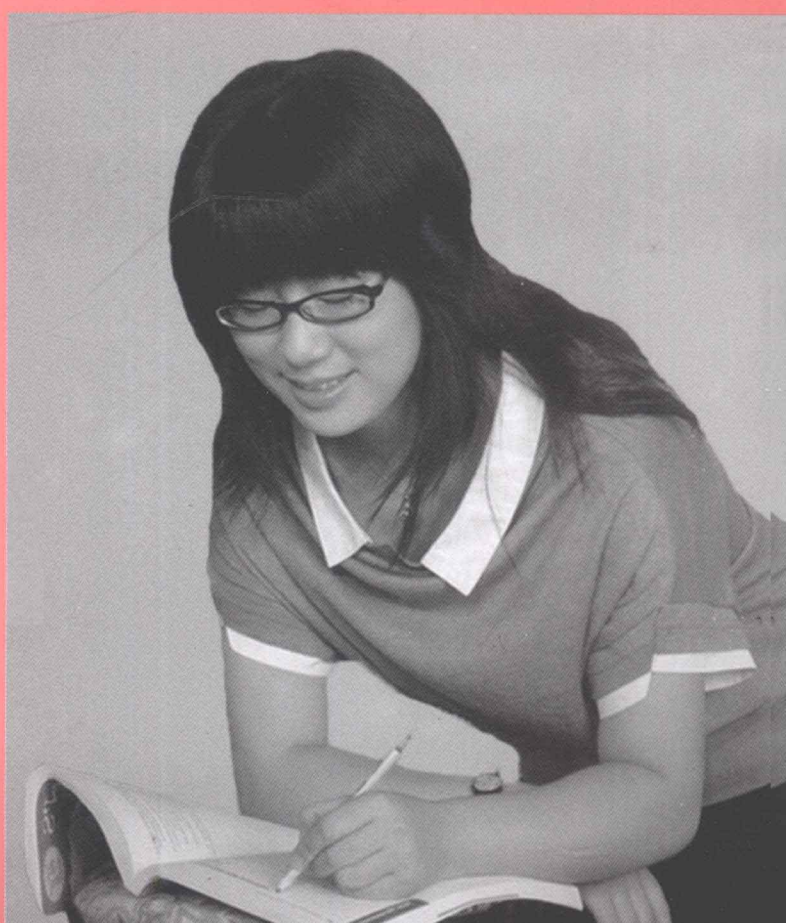

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Preface 前言

This 10th edition of *Barron's SAT Subject Test Physics* contains corrections to the 9th edition and some new material. Unlike other review books, which just present practice test questions, this book provides you with full content review, tips for improving problem-solving skills, test-taking strategies, special sidebars that highlight important concepts, and self-assessment rubrics to improve your test score.

The book begins with an introduction to the SAT subject test in physics. Remember that any review book can give you only an approximation of the full content of an SAT subject exam. Since the material contained on an actual exam is owned by copyright, all tests included in this book (as well as percentages of content distribution) are necessarily simulated to reflect the level and types of questions you may encounter on the actual exam.

Following the brief introduction to the structure of the exam and enhancing problem-solving skills, the book presents a diagnostic exam that can be used to see how well you do the first time taking a practice exam. After taking the diagnostic, you can cross-reference each question with the appropriate review chapters to reinforce what you have learned during the year. Full answers and explanations are provided for each question.

The remainder of the book contains an extensive review of content material covered in a typical high school physics class. Review questions are at the end of each chapter. I encourage you to work on them as well. Full answers and explanations are provided. Three additional practice exams are provided that also contain full answers, explanations, and self-assessment tables. Please remember that on the actual SAT exam, you *may not* use a calculator, nor will you be provided with a formula sheet. The tables provided in the appendixes are to help you become familiar with the necessary equations. A glossary and useful math review are also in the appendixes. This is a comprehensive review book that can help give you the tools needed to succeed.

It is both an honor and a pleasure to assist in the preparation of this latest edition. My editor at Barron's, Linda Turner, has been very helpful with her insight and assistance. My colleagues Robert Draper, Pat Jablonowski, and Joseph Vaughan have always been generous with their continued advice, expertise, and encouragement on content and pedagogy. I would like to thank a former student, Alex Ramek, who was helpful in designing the self-assessment guide. Finally, I would like to thank my wife, Karen, as well as my daughters, Marissa and Ilana, for all of their continued love, understanding, and support.

Jonathan S. Wolf
January 2010

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- Contacting the College Board
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- Tips and Strategies for Taking the Examination

PRELIMINARY 前言

Before we discuss examinations, you should make sure that you have a copy of the College Board pamphlet: *SAT Subject Tests Preparation Booklet.* If you don't have them, you should be able to obtain them from your high school advisor or guidance office. If not, write to

College Board SAT Program
P.O. Box 6200
Princeton, NJ 08541-6200

There is also a College Board Internet site at *www.collegeboard.com.*

In the pamphlet, start reading the material at the beginning, such as Planning to Take the Tests, How to Register, How to Prepare for the Tests, and The Day Before the Tests.

Then turn to the section on the Physics Subject Test, which describes the test and includes sample questions and answers. Because the instructions for the test may have changed, be sure to read them carefully. This will save you time on the actual test.

THE EXAMINATION CONTENTS 考试内容

The College Board does not publish copies of former examinations each year. The physics examination is made up annually by a group of experts who are guided by a knowledge of what is commonly taught throughout the country. You will, therefore, be well prepared for the test if you know and understand what is taught in a good secondary school course in physics and if you get some practice in the types of questions used. It is the aim of this book to help you in both areas.

TIP

The exam has 75 multiple-choice questions.

The questions on the physics test are based on the large subject-matter areas of mechanics; optics and waves; electricity and magnetism; heat, kinetic theory, and thermodynamics; and modern physics. Some of the questions ask for mere recall of knowledge. Other questions are designed to see if you really understand concepts and principles, if you can reason quantitatively, and if you can apply scientific concepts and principles to familiar and unfamiliar situations. Some questions involve more than one physical relationship. All questions are in the multiple-choice format, requiring you to choose the best answer from among the five choices given. The prac-

TIP

Review all content material to refresh your memory.

tice tests at the end of this book reflect the subject-matter contents and the question types you will encounter on the actual test.

The material covered on a given exam can vary, so only an approximate guide to content distribution can be provided. The topics generally covered are mostly included in a typical high school curriculum. If a particular topic is not covered in your class, you can use the material provided in this book to help you.

A typical exam might include the following topics:

Mechanics—approximately 40% of test
力学——约占考试内容的40%

- **Kinematics**: can include concepts such as velocity, acceleration, one-dimensional motion, graphical analysis, and projectile motion
- **Dynamics:** can include vectors, forces, Newton's laws, static equilibrium, circular motion, gravitation, Kepler's laws, and simple harmonic motion
- **Energy and Momentum:** can include work, power, potential and kinetic energy, impulse, momentum, and conservation laws

Electricity and Magnetism—approximately 20% of test
电学和磁学——约占考试内容的20%

- **Electrostatics:** can include electric charges, forces, Coulomb's law, electric fields, electric potential and potential difference, and capacitors
- **Electric Circuits:** can include current, resistance, Ohm's law, DC circuits, batteries, series and parallel circuits, and work and energy transfers in simple circuits
- **Magnetism:** can include magnetic fields, permanent magnets, electromagnets, fields caused by moving charges, forces on moving charges in magnetic fields, hand rules, Faraday's law of induction, and Lenz's law

Waves and Optics—approximately 20% of test
波和光学——约占考试内容的20%

- **General Characteristics of Waves:** can include amplitude, wavelength, frequency, period, wave velocity, wave forms, superposition, Doppler effect, reflection, refraction, interference, and standing waves
- **Light:** can include reflection, refraction, and Snell's law
- **Optics:** can include ray tracing, and image formation in both mirrors and lenses
- **Physical Optics:** can include interference and diffraction of light, colors, and polarization

Heat and Thermodynamics—approximately 8% of test
热能和热力学——约占考试内容的8%

- **Thermal Properties of Materials:** can include specific heat, latent heats of fusion and vaporization, changes of state, calorimetry, and thermal expansion
- **Laws of Thermodynamics:** can include the first and second laws, entropy, efficiency of heat engines, and gases

Modern Physics—approximately 8% of test
现代物理学——约占考试内容的8%

- **Quantum Theory of Light:** can include photons, the photoelectric effect, and photon momentum

- **Atomic Physics:** can include the Bohr model, Rutherford model, energy levels, and spectral lines
- **Nuclear and Particle Physics:** can include radioactivity, nuclear reactions, fission, fusion, nuclear models, and fundamental particles
- **Relativity Theory:** can include length contraction, time dilation, and mass-energy equivalence

Miscellaneous—approximately 4% of test
其他——约占考试内容的4%

- **General Concepts:** can include the history of physics and general ideas that may cover all other topics or multiple topics
- **Analytical Skills:** can include graphical analysis, proportional reasoning, dimensional analysis, measurements, and general math skills
- **Contemporary Physics:** can include astronomy, superconductivity, and other modern ideas

Additionally, the types of questions on a given exam can involve *simple recall* (approximately 25% of test), *single concepts* (approximately 50% of test), and *multiple concepts* (approximately 25% of test). Remember, all of these percentages are only approximations. The exam designers can vary the percentages from exam to exam and from year to year.

TIPS ON HOW TO SOLVE PHYSICS PROBLEMS 物理题解题技巧

Have you ever tried to solve a physics problem only to quit in frustration because you didn't know how to get started? Many students find themselves in this situation. In physics, success and achievement require more than just being able to memorize and use formulas, and there is also more to mastering physics than just learning how to solve problems. First, you must understand what the problem is asking you to do. Then, you must access from your memory all the information you feel is related to the ideas being discussed in the problem. Next, you must determine which information is relevant to the problem. Finally, you must decide on a solution path that will hopefully lead you to the correct answer.

A **problem** can be defined as a situation in which you want to achieve a goal but are unsure how to go about it. There are many elements in a problem presented to you. Some of this information is explicit and some may be implicit. Additionally, the goal of the problem may be implicit. For example, to answer a "yes or no" problem, you must first ascertain which quantity or quantities need to be determined before you can answer in the affirmative or negative. Effective studying and reviewing means that you must develop an instinct for certain familiar problem-solving types and techniques.

TIP

Check to see if you can eliminate some choices as obviously incorrect. Also be sure to check units.

The first element of a problem consists of the **givens**. This is information that is explicitly provided in the problem statement. As you read a problem, the words that are associated with concepts begin to access information from your memory. What kind of information is retrieved and the form that recollection takes depend on what you already know about the subject, the type of problem, your experience, and your expertise.

"Difficult" problems are difficult because sometimes the information given is implicit or not well defined. If you are used to solving certain types of problems,

you come to expect that a problem will look and read in a certain way. Even so, identifying the givens is the first step after accepting the problem in your mind; that is, after you initially read the problem, you begin to form a mental representation of it. This representation may start with a redescription of the problem (perhaps as a mental image or model of the situation), followed by a translation of the problem into symbols that link concepts already known with the given information.

The representation may be similar to a map, in which associated knowledge is linked by "operators" that tell your brain how to deal with particular concepts using formulas or learned "rules of thumb" for problem solving. **Problem solving** consists of the mental and behavioral operations necessary to reach the goal of a solution. When you begin working on a problem, you rely on stored knowledge about the particular problem, the subject area, and your past problem-solving experience.

The second element in a problem consists of the **obstacles**. These are the factors that prevent you from immediately achieving your goal. In a multiple-choice question, the correct answer is accompanied by a series of "distractors" that may be closely linked to the answer. If the question is not a simple recall of information, you may have to use some of the methods mentioned above. Since you may not use a calculator on the exam and you are not provided with a formula sheet, you must rely on your own memory and problem-solving skills. Deciding on the proper method (or path) for solving the problem most efficiently is the main focus of problem solving as a process.

TIPS ON HOW TO TAKE THE TESTS 考试技巧

Remember

No calculators are allowed on the exam.

The examinations at the end of this book are not copies of former tests, but practice with them should be valuable to you. However, be sure to read the instructions given with your actual test. Note the amount of time allotted, and recognize that you may not be able to answer all questions in the available time. No calculators are permitted.

TIP

Try to use approximations or estimations to solve calculations quickly.

The questions are not of equal difficulty, but each question usually gets the same credit. Do not waste time on questions that seem difficult or time consuming. Go back to them at the end of the test, if you have time. Time can often be saved in numerical examples by making approximate calculations. Don't worry if you can't answer all the questions. Probably no one taking the test can, and completion is not needed for a perfect score. Should you guess? If you know anything about the subject matter of the question and can eliminate some of the choices, it is advisable to guess. A completely random guess, however, may cause you to lose a fraction of a point for an incorrect answer.

Pay attention to units. By doing so, you can catch many mistakes. All problems in this book are in (metric) SI units, which are explained more fully in Chapter 1.

When taking the practice tests in this book, do not stop at the end of 1 hour. Follow the above advice, and try to answer all the questions eventually. Practice keeping track of time without wasting it.

Each of the practice tests includes 75 questions. On the actual examination the questions are carefully evaluated, and individual performance is compared with group performance before a score is given.

Also, as cautioned above, note whether the **directions** on your test are the same as those used on the practice tests in this book. *When you take the test, be sure to read the instructions given.*

Your final score on an actual SAT Subject Test in Physics ranges from 200 to 800. These scores are based on a scaling formula developed by ETS at the time of the exam. It is not possible to determine your actual score on a practice exam, but you can determine your raw score and then get an *approximate* sense of where you might fall on a scaled curve.

To calculate your raw score, count the number of questions correctly answered and then subtract one quarter of the number of incorrect questions:

$$\text{Raw score} = \#\text{ correct} - (\#\text{ incorrect} \times \tfrac{1}{4}) = \_\_\_\_\_$$

The second term in the equation is a "guessing penalty." While you should always try to answer as many questions correctly as you can, random guessing will not significantly increase your score. It is always better to eliminate as many choices as possible before even attempting an "educated guess."

Typically, raw scores between 65 and 75 will earn you a scaled score of approximately 800. A raw score around 45 will typically compute to a scaled score of approximately 700. **These scaled-score ranges are only approximations. You should not use them as absolute indicators or predictors of what your own score might be on the actual exam!**

TIP

Try not to guess. Your score is based on the number of questions correct minus a penalty for wrong answers.

Summary 总结

- Contact the College Board, and familiarize yourself with all registration requirements.
- Familiarize yourself with the exam content and format.
- Make sure you always check your units.
- You are not allowed to use a calculator on the exam.
- Try to simplify calculations using approximations or estimations.
- Try to eliminate one or two choices to minimize guessing.
- The exam is scored based on the number of questions correct minus a penalty for answering questions wrong.

Diagnostic Test 摸底考试

The first of the four practice tests for the SAT Subject Test Physics is to be used as a diagnostic. This means that you should take this exam to assess your level of understanding. On the basis of how well you perform, you may want to organize a review schedule for some of the specific content material in the chapters that follow. If you are already comfortable with the content, view this diagnostic test as just another practice exam. Do not use a calculator.

Here is some helpful information:

1. All questions provide five choices, designated as (A)–(E). Many questions come in sets and are based on the same information.
2. Some questions call for the interpretation of graphs.
3. Sometimes there are several questions on the same topic.
4. In some questions four choices are correct, and you are asked to select the exception. These questions contain a word in capital letters (NOT, EXCEPT).
5. Sometimes the answer choices are given first and are then followed by the question.
6. In some questions with more than one correct answer, you are asked to select a combination of statements that provide the best answer. On the actual test, the individual statements will probably be designated by the Roman numerals I, II, and III, as in this book.
7. It is advisable to consider all the lettered choices before you select your answer.

GOOD LUCK!