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# 数学 & 科学推理

Barron's ACT Math and Science Workbook, 2nd Edition

[美] Roselyn Teukolsky, M.S. 编著

### In-depth preparation includes—

- Breakdown of all math topics included on the test
- Summary of data representation, research summaries, and conflicting viewpoints passages
- In-depth discussion of the scientific method
- Strategies for solving all types of math and science problems
- Variety of time-saving tips
- Two full-length practice tests—1 math and 1 science—with comprehensive answer explanations



北京语言大学出版社  
BEIJING LANGUAGE AND CULTURE  
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# ACT Overview and Strategies

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## CHAPTER GOALS

- Description of the test
- Your ACT score
- Questions to consider
- Why use a math and science workbook?
- Test day
- Strategies for the ACT

If your life plan includes going to the college of your choice, then acing the ACT is a huge step forward in achieving your dreams. Welcome!

You probably already know that thousands upon thousands of students apply for top colleges every year, and many suffer the agonies of rejection. For example, Harvard and Yale each have an acceptance rate of about 8 percent, while Columbia University's rate is not much better at 12 percent. Pomona College in California is at 18 percent, while Williams College in Massachusetts is at 19 percent. Many, many colleges have an acceptance rate of less than 25 percent.

What you clearly need is an edge. Being an A student at your school and an upstanding citizen in your community all count in your favor, no question about it. Few things shine as brightly for an admissions committee, though, as the sparkling gem of a great ACT score.

## DESCRIPTION OF THE TEST

By now you probably know what the ACT Test looks like, but here is a quick overview. The test time is 2 hours and 55 minutes, but you must add half an hour if you take the optional Writing Test. The four subject tests are, in the order you will take them, English, Math, Reading, and Science. When you take the test, you will be given a short, 10- to 15-minute break between the Math and Reading Tests.

All questions are multiple choice, except for the Writing. Here is the breakdown of the first four tests:

|         |             |               |
|---------|-------------|---------------|
| English | 45 minutes  | 75 questions  |
| Math    | 60 minutes  | 60 questions  |
| Reading | 35 minutes  | 40 questions  |
| Science | 35 minutes  | 40 questions  |
| Total   | 175 minutes | 215 questions |

That means you have less than a minute per question—yikes! Stay calm. Many of the questions are easy, and you will zip right through them.

## YOUR ACT SCORE

Your *raw score* is the total number of multiple-choice questions you got right. Your *scaled score* is the score from 1–36, a composite of all your scores, the all-important score that goes to colleges. This is the score you will tell people (or not) when they ask you what you got on the ACT.

For each of the four subjects you will receive a scaled score from 1–36. Within each subject—except for Science—you will get a further breakdown of subscores. For example, in Math you will receive three subscores:

|                                |      |
|--------------------------------|------|
| Precalculus/Elementary Algebra | 1–18 |
| Algebra/Coordinate Geometry    | 1–18 |
| Plane Geometry/Trigonometry    | 1–18 |

These scores are meaningful only if you know where you fall compared with other students. About half of all students taking the ACT have scores between 17 and 23. A score of 17 places you in the 28th percentile, which means that you scored better than just 28 percent of all students who took the ACT. Clearly, if you score 17, you have your work cut out for you. On the other hand, a score of 23 places you in the 76th percentile—not bad!

You should know that many top colleges will eliminate you if your ACT score is lower than 22. You will, however, be in the top 5 percent of all students if you have a score of 28 and the top 1 percent if you score 31.

## QUESTIONS TO CONSIDER

### ACT or SAT?

Colleges claim that they do not play favorites, that the ACT and SAT tests are given equal weight. So how do you choose which one to take? The time factor is an obvious difference. The ACT lasts 2 hours and 55 minutes plus an additional half hour if you take the writing section. The SAT lasts 3 hours and 45 minutes. Other obvious differences between the ACT and SAT are that the ACT tests science and trigonometry, while the SAT does not.

Less obvious is the fact that the ACT is more knowledge based than the SAT. The ACT measures math and English skills that are part of rigorous college-prep high

school courses. The SAT is trickier somehow, more akin to puzzle solving. In this sense, the ACT is a fairer test of your high school achievement.

Here is something purely anecdotal. Both test publishers will say that students who have done well in school will do well on their tests.

## Junior or Senior?

OK, it is a good bet that you have already decided whether to take the ACT as a junior or senior. Still, if you are a junior and are debating whether to take the test this year, you should know that there are several advantages to taking the ACT as a junior:

- If you are in a rigorous college-prep program with accelerated and AP courses, the ACT material will still be relatively fresh in your memory when you take the test.
- You are likely to have just completed a good precalculus course, which contains most of the coursework required for the ACT Math Test.
- If you think you can improve your score, you get more opportunities to have another shot at the ACT.
- Your ACT score gives you an additional guide to selecting colleges.

## WHY USE A MATH AND SCIENCE WORKBOOK?

### The Math Section

First consider the math. Most test takers can get the easy questions right, those straight-forward questions that ask you to perform the type of simple computations you've been doing in your sleep since middle school. Many test takers can handle the no-frill elementary algebra questions. Let's face it, you have been solving linear equations for a long time.

However, to attain a score that impresses admissions and scholarship committees, you need to crack a good number of the harder questions. The ACT Math Test calls on you to have at your fingertips topics from your rigorous algebra 2 and trigonometry courses, the courses where you dealt with complex numbers, trig equations, matrices, and conic sections, among other enticing goodies. This workbook will help you brush up on all of these topics as well as give you lots of practice ACT questions based solely on the harder stuff.

In the math part of this workbook, you will find a topic-by-topic review of the more challenging math content that you should know, with lots of practice in solving problems that require specialized knowledge. For the tricky math questions that cut across single-topic lines, some "nonclassroom" strategies will show you how to achieve fast, successful results. Cracking a good number of harder math questions on the ACT is a good part of getting the edge you need.

A complete practice Math Test with detailed explanations to all questions will help you to assess your progress.

As you work through the math section, you will spot several icons, each of which provides a useful test-taking tip:





**Time saver:** Look for this icon to learn a shortcut—how to speed up without losing accuracy. High scorers on the ACT know that time is of the essence.



**Gold star:** Here you will find a tried-and-true technique that would earn you a gold star from your math teacher. Believe it or not, such techniques are sometimes the best approach.



**Neat trick:** For some problems, a nifty maneuver will pull the answer out of a hat. Knowing tricks like these helps give you the edge that you need.



**Active pencil:** With pencil in hand you can often work wonders as you mull over a problem. Smart test takers stay on top of their tasks by writing as they think. This helps them to stay focused.



**Calculator:** Look for this icon to find an alternative route to the solution. Judicious use of your calculator can save you time and effort on many questions.

## The Science Section

It is a sad fact but true: the ACT Science Test is a source of particular anxiety for many students who are otherwise quite confident about the ACT. There is, however, lots of good news about the Science Test:

- Unlike the Math Test, the Science Test is *not* content based. You do not need to know all of high school science. All you need to bring to this test are your common sense, your ability to focus, and a can-do attitude.
- The format of the test is unvarying and therefore predictable. It *can* be learned!

The science part of this workbook will teach you about the three distinct types of science passages that appear on the ACT Test and the best way to approach each type. Before you jump into any actual ACT passages, however, you will:

- Become an expert in reading graphs and tables.
- Nail down the scientific method and how to interpret experiments.
- Learn specific four-step drills to help automate your approach to tackling a science passage.

In short, this section of the workbook will teach you the Science Test. As you know from previous experience in test taking, knowing the test is half the battle. There is a complete practice Science Test at the end of this workbook, with answers and explanations. Use this to assess your progress after you have tackled the passages in the focus chapters.

### TIP

The Science Test is *not* content based.

Throughout the science section, you will find:

- ACE tips that will remind you how to do well on the Science ACT.
- Coaching on the side to keep you on track as you proceed through a science passage.
- Warm-up passages that will give you a gentle introduction to sample ACT passages.
- Drills that you should use to focus your thinking.
- Sample jottings you might make to nail the content of each passage.

Wait and see—practice will boost your confidence and, more importantly, your ACT score.

## TEST DAY

It is not enough to bring your wits to this test. The ACT Test is demanding and requires mental and physical stamina. You must come prepared. This is a big and important day for you, and you want to guarantee that everything goes smoothly. You don't want any unanticipated disasters—like losing a contact lens—to sap your mental energy and put you in a funk before you even get started.

Think of each of the following the night before the test:

- What to wear? If they forgot to turn on the heating or air-conditioning in your testing room because it is a Saturday, you should not be one of those who notices it. Plan to wear comfortable clothes with plenty of layers.
- What to eat? Not a breakfast person? Well, tomorrow is the day to make an exception. Eat a healthy power breakfast! You will not be allowed to eat or drink in the testing room.
- What time to rise and shine? You need to be at your test center at 8 A.M. Late-comers will not be admitted. It is crucial that you set a reliable alarm clock and arrange for backup from a family member. Don't forget to build in time for breakfast and negotiating traffic. It goes without saying that you know ahead of time exactly where the testing site is.
- Pre-ACT party? Forget about it! You need a good night's sleep.
- What to take to the test tomorrow? Here is a checklist:
  - ✓ Your admission ticket.
  - ✓ Proper photo ID, like a driver's license or student ID. (See "Before the Test" below.)
  - ✓ Several sharpened #2 pencils with good erasers that leave no marks.
  - ✓ Your favorite calculator with *fresh* batteries for the Math Test. (See the next chapter for a description of allowable calculators for the ACT.)
  - ✓ A spare calculator, if possible.
  - ✓ A spare pair of glasses or contact lenses if you wear them.
  - ✓ A watch. Not all testing rooms have wall clocks.
  - ✓ A snack and drink for the break. (Have them outside the testing room!)
  - ✓ A small pack of tissues.

Do not bring books, notes, scratch paper, highlighters, dictionaries, and so on. They will not be allowed in the testing room.

### TIP

Smart test takers know the tricks of the trade and apply them accordingly.

### TIP

Test your erasers ahead of time. It is important that the computerized scoring machine does not pick up stray marks.

A special note about your cell phone—you know, that little gizmo that you can't live without? *It needs to be turned off.* If it goes off anywhere near you during the test, you will be disqualified and sent home. Ouch!

## STRATEGIES FOR THE ACT

By now you know that the ACT is a challenging test, and you need to be prepared. In this book, you will find tips and strategies specifically geared toward the Math and Science Tests. This particular section, however, deals with general strategies that apply to all tests on the ACT. Remember, you are a smart person, and you can crack this nut.

### Before the Test

- Find out about the test. Get up-to-date information about the ACT at its official web site, *www.actstudent.org*. Notice that there are strict new requirements for providing a photo ID. Also, take note that the first and last names on your photo ID must be the same as the names on your ACT ticket. If there are significant differences, you will NOT be admitted to the test. Bottom line: don't get yourself disqualified from the ACT because you were careless about registering!
- Speak to teachers and counselors who know about this test, and to students who have taken it. Their insights could be invaluable to you.
- Familiarize yourself with the format of each individual test. This book will help you in math and science. There are similar books with practice in English, reading, and writing.
- Plan on taking the ACT plus Writing Test because some schools require a writing score. The last thing you need is to have to retake the entire ACT test because you later decided to apply to a school that required the writing score.
- Become familiar with the instructions *for each test*. Yes, you will be given time to read these on the test day before the actual test, but knowing them in advance is helpful and comforting.
- Practice! The really good news is that the test does not vary in its format—same types of questions, same approaches to passages, same number of questions in certain topics. Just as you break the code for any of your teachers, so you can learn this particular test. You are doing exactly the right thing, working through a book such as this. Practice may not make perfect, but it sure as heck will improve your score.
- Learn the material that you need to know. This means that you should refresh your knowledge and skills in the math and English content areas. This book will help you do that in math.
- Set aside a regular time for ACT study. You probably have an insanely busy life with extracurricular activities, sports, 12 hours of homework every night, plus social dates. If you do not build ACT study time into your schedule, it is just not going to happen.
- Learn how to pace yourself during an ACT Test. This is a critical skill that you can develop by taking timed tests when you practice. The different nature of the various ACT tests calls for different time strategies.

#### NOTE

If you find that much of the course content in math is unfamiliar to you, you may want to postpone taking the ACT for a year while you take an Algebra 2 and Trigonometry course. This is much more effective than a cram course in trig, for example.

## Five Minutes Before the Test

Use the bathroom, even if you think you don't need to go!

## During the Test

Here are several different strategies that will serve you well, no matter which of the multiple-choice tests you are taking.

### ANSWER EVERY QUESTION!

There is no penalty for guessing. Notice that this is different from “solve every problem.” Do your best and, if necessary, guess. Resist the impulse to leave a question that you have no clue about blank. The ACT Test is different from tests at school, and you must adjust your strategy accordingly. Often you will be able to eliminate some of the choices, which improves your shot at the right answer.

If you are going to run out of time, take a few seconds to bubble in answers to *all* of the remaining questions. Remember, the hard questions are worth the same as the easy ones, so answer them all.

### TACKLE THE EASY QUESTIONS FIRST

It is human nature to start at question 1 and proceed sequentially through the set of questions. This makes sense if the questions are in increasing order of difficulty. Unfortunately, this is not necessarily so on the ACT. You must adopt a strategy of skipping questions when a solution method is not immediately apparent to you.

Here is the strategy. Work quickly through the entire test, answering only questions that appear easy to you. (There will be many of these.) Skip the questions you do not like. Circle these in your test booklet so that you have a speedy way of coming back to them. After your first pass, go back and spend time on the harder questions. This approach has several advantages:

- The comforting feeling of solving many problems quickly will settle you down and boost your confidence. It is good to approach the more challenging questions with a positive mindset.
- You will avoid the tragedy of running out of time before getting to some doable questions toward the end of the test.

This approach does have potential disadvantages:

- Extra care is required to keep track of which questions must still be done.
- You encounter the danger of solving a question correctly and then filling in the wrong oval on the answer sheet (disaster!)

### PACE YOURSELF

Timing is important, but do not let the time issue dominate your thinking. You must never lose sight of your main goal, which is to answer the questions correctly.

#### NOTE

The test proctor will give you a five-minute warning at the end of each test.

## CHECK YOUR TEST

Any time left over should be used to check your test. It is not the time for meditation, yoga exercises, or a quick nap. You need to take advantage of every minute of time allotted for each test. You are not allowed to proceed to the next test. So use leftover time to go back and check the current test.

- Check that you have marked only one answer per question on your answer sheet.
- Check that you have answered every question on the test.

## YOUR TEST BOOKLET

Use your test booklet wisely. It is yours for the duration of the test, and you can write in it.

- Circle the questions that you must return to.
- Underline important points in the passages.
- Mark up graphs and diagrams to clarify the passages or questions.
- Jot down any helpful thoughts and conclusions. The science and math sections of this workbook will have more specifics on how you can use your test booklet to great advantage.

### NOTE

If you are not taking the test in the U.S., you may not be allowed to write in the test booklet.

## THE ANSWER SHEET

Take great care with how you mark your answer sheet. The oval for your answer choice should be completely filled in and should not overlap with the adjacent ovals. To change an answer, you need to erase thoroughly without leaving stray marks on the sheet. Remember, these sheets are electronically scored. Careless bubbling in of answers may cost you precious points that you did not deserve to lose.

## USE CAUTION

Be aware of subtle differences in multiple-choice questions from test to test. The Math Test asks you for the “correct” answer, while the English, Reading, and Science Tests ask for the “best” answer. This is less clear cut. An answer choice may be quite reasonable within the context of a passage; nevertheless, it may be wrong in the context of the ACT test, because it is not the *best* answer! In the science section of this workbook are several examples of such questions.

## CONCENTRATE

Concentrate on the task at hand. When a test on the ACT is over, it is over. You cannot go back to it. It is history. Do not obsess about the questions you could not do on the last test. Focus your mental energy on the questions that you will now tackle, on the current test. Smart people do not worry about stuff that they cannot change.

Here’s a final thought. The English, Math, Reading, and Science Tests are all multiple choice. In other words, they are giving you the right answer! You just need to select it.

PART 1

---

THE MATH  
SECTION

---



# Overview of the Math Test

## CHAPTER GOALS

- What topics are on the test?
- Question types
- Calculators

**A**s is true of the Science Test, the Math Test on the ACT follows a predictable format, right down to the expected number of questions per topic!

## WHAT TOPICS ARE ON THE TEST?

By now you know that the Math Test contains 60 multiple-choice questions for which you will be given 60 minutes. Each question will present 5 answer choices, either A, B, C, D, E or F, G, H, J, K, in alternating questions. This is to help prevent entering a choice for the wrong question. Math is the second test in the ACT sequence of tests, following English. Reading comes next. Once you have started tackling the Reading Test, you will not be allowed to go back to math.

The ACT test is based on the algebra and geometry courses that you took (or are currently taking) in high school. If you are not sure how your high school stacks up compared to the typical high school or, for that matter, how you stack up, here is a breakdown of topics on ACT math:

- Pre-algebra
- Elementary algebra
- Intermediate algebra
- Coordinate geometry
- Plane geometry
- Trigonometry

### PRE-ALGEBRA: 14 QUESTIONS (24%)

You must know all the early topics in arithmetic: numbers, fractions, decimals, positive powers, square roots, ratios and proportions, percents, multiples, factors, absolute value, order, simple equations, probability, counting, and simple statistics.



**ELEMENTARY ALGEBRA: 9 QUESTIONS (15%)**

You must know topics from your earliest algebra course: variables, substitution, simple operations on polynomials, factoring, quadratic equations solved by factoring, linear equations, inequalities, exponents, and square roots.

**INTERMEDIATE ALGEBRA: 9 QUESTIONS (15%)**

You must know harder algebra: the quadratic formula, rational expressions, radicals, inequalities, absolute value, sequences, simultaneous equations, quadratic inequalities, functions, matrices, roots of polynomials, complex numbers, and functions.

**COORDINATE GEOMETRY: 9 QUESTIONS (15%)**

You will be asked about the number line,  $xy$ -plane, graphs of polynomials, circles, curves in the  $xy$ -plane, equations, slopes, parallel and perpendicular lines, distances, midpoints, transformations, and conic sections.

**PLANE GEOMETRY: 14 QUESTIONS (24%)**

You need to know information from your favorite high school geometry course: triangles, rectangles, parallelograms, circles, angles, parallel and perpendicular lines, transformations, techniques of proof, simple three-dimensional geometry, perimeter, area, and volume.

**TRIGONOMETRY: 4 QUESTIONS (7%)**

You will encounter a small section about right triangle trigonometry, radians, graphs, identities, equations, and problems that require you to use the sine or cosine rule.

Did your entire mathematical life just flash before your eyes? Never fear—all topics will be reviewed in these pages, so you can set your mind at ease.

According to ACT spokespeople, their test favors the student with a good grasp of material taught in rigorous high school courses. If you are insecure about the extent of your grasp, practicing the typical ACT-like math problems presented in this workbook will bring you up to snuff. As with every skill you aspire to excel at, the buzzword is practice!

**What Is Not on the Test?**

Something you should not expect to find is a bunch of formulas at the start of the ACT math test (as is provided on that other test, the SAT). You are expected to know basic formulas and relationships, like areas of triangles and circles and also the side ratios of special triangles.

If a question requires you to use a particular formula, the ACT often provides it in the question. Having said that, you should know that most of the problems on the Math ACT depend on basic formulas and skills rather than complex formulas and extensive computation. Many questions emphasize reasoning applied in practical situations. In fact, if you find yourself stuck in an endless forest of calculations