In the Quantitative section of the GRE, you'll have 45 minutes to complete 28 questions.

Contrary to what you might expect, GRE math, in general, is easier than math from the SAT – but be warned that it can be trickier. While both tests depend on the basics of arithmetic, algebra and geometry, the good news is that the GRE does not include any Algebra II or Trigonometry – although if you do well on the CAT, you may see a few topics that you rarely if ever see on the SAT, such as data analysis and statistics. But you'll also notice that while the SAT gives you basic formulas at the beginning of the math sections, the GRE does not. Nor does the GRE note when figures are not drawn to scale – they're usually not. (The SAT ALWAYS notes when figures aren't drawn to scale, as a rule drawing them correctly) And while you are encouraged to use your calculator on the SAT, you are forbidden to use calculators during the GRE.

This last would seem to be a great handicap. In fact, it is a great boon – without a calculator, the student can't rely on mindless number crunching. The Quantitative sections of the GRE, in other words, require that the student either guess or pay attention!

APPROACHING MATHEMATICS

Unlike other courses in test preparation that exlusively emphasize material content, this course investigates the process of mind as well as the hidden, key ingredient for improvement beyond the minimal. That is not to say that material content is not covered through our practices and exercises, but rather that process and approach are understood as the fundamental building blocks for attention and success. Consequently, our perspective might seem antithetical to 'teaching math' for most mainstream educators, so focused on the trees (math content) that they can't see the forest (of mathematical thinking and understanding).

When I was in high school, I was the kind of student that a lot of teachers dread. I was seldom concerned with the academic material at hand; I always wanted to know what kind of use I would get out of the lesson later in life: Why do we need to know this? Are we ever going to use this again? Very few of my teachers even attempted an answer beyond the usual reference to some test at the end of the chapter, or quarter, or course. Some mentioned the need for current material in higher courses, and all defended the necessity for certain mathematic skill-sets in a well-educated person. But I honestly cannot think of a single one who addressed the *roots* of good education: how we think, regardless of content.

The point of mathematics, then, though a prerequisite for a number of disciplines and sciences, is *not* content. Are we ever going to use quadratic equations in our life after high school? The short answer, for most of us, is no. It would be rare for the matter of quadratics to come up in any context except high school or college math. Unless we are involved in specialized fields, we will most likely never again work with algebraic word problems, or degrees in a polygon, or volumes of cones. The point, rather, is that mathematics is a *language*, reflecting a certain understanding of the world. Math represents a way of thinking and expressing. More properly, math is a *tool* of thought, in the same way that any other language not only helps us to communicate our feelings, opinions and understanding, but actually helps us to shape our reflection and expression.

Approaching math as a language may take some of the pressure off for students who think that they either never learned some math in the first place, have never been good at certain kinds of problems involving particular kinds of math, or have simply forgotten swaths of what they studied in high school. Thinking of math as a language that we all learned and now speak, albeit with different accents and degrees of fluency, makes clear that there is very little that you have to 'remember' for the quantitative sections – we have only to speak a language we all learned (but with which we are now rusty).

In short, math is a way of communicating and thinking native to the human brain, but seldom practiced very deliberately in general (or polite) company. Facing confusion in a mathematical way is to approach problems as matters of clearing up misunderstanding – a confused word or two – rather than striving to remember the detail of what we were taught and should have learned years ago. In fact, there is very little for us to remember beyond what you'll find you do quite naturally when given the opening. So be confident: while your skills may be rusty, they are most likely absolutely adequate for answering every problem in these sections correctly, within the allotted time.

But, like Reading, doing well on these quantitative sections also requires that you are familiar not only with the process of our language, but with the building blocks of communication. In the Reading sections, that means vocabulary words. In the math section, that means all the basic skills and content of arithmetic, algebra, geometry and data analysis that can be found in your Mathematics Review file, in your GRE prep software. Again, keep in mind that our approach is not for you to memorize any of these definitions or procedures, but rather to use them in practice. Through practice, you'll find that even certain areas of math that made very little sense to you when you saw for the first time in high school are now much more understandable – and *usuable*.

SUMMARY OF DIRECTIONS FOR PROBLEM SOLVING

Select the best of the answer choices given.

PROBLEM SOLVING: Set-up, Substitute and Simplify

Approaching math as a language, and math problems as problems of comprehension and attention, keeps us focused on what is most important in problem-solving: keeping track of what you know. This is where your pencil or pen is going to be most important.

My approach here recognizes that human attention and imagination are not infinite. That is, we can only hold so much in our head at once. Good problem-solving is never about remembering – it's always about paying attention to what we know and what we do not. Memory serves us in this approach, but doesn't run the show. What you'll find is that if you pay attention to one thing at a time, and never strive to 'remember', you'll always have what you need when you need it! If you try to keep things – concepts, definitions, examples – in your head, you'll have very little mental space left for the answer to come.

Here's our basic approach:

1. **Read the problem**, without trying to answer the question. Just read, without focusing on any detail in particular, but rather to get the general sense of the problem.
2. **Read the answers**. While reading the answers early in your Reading section questions often adds to whatever difficulty you have, reading them early in the math often helps direct your attention and establish aim and context.
3. **Work the 'S' method**:

SETUP
SUBSTITUTE
SIMPLIFY

SET-UP the problem by translating word-problems into mathematical language symbols. Alternatively, you can ask yourself: what is this problem about? What principle is involved? If the question is about the area of a circle, the very first thing I write down is:

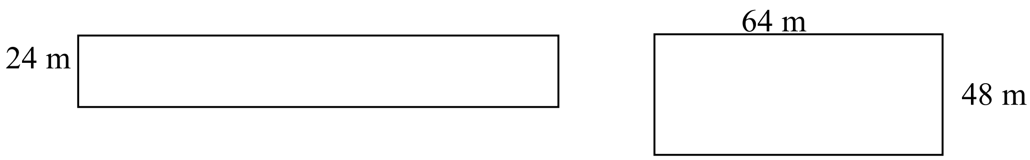
$$\mathbf{A = \Pi\, r^2}$$

If the question sets me up by asking,

> What is the perimeter, in meters, of a rectangular playground 24 meters wide that has the same area as a rectangular playground 64 meters long and 48 meters wide?

The first things I write down are the definitions of perimeter and the area of a rectangle, and I draw two rectangles because it calls for two.

P = sum of sides **A = *l* X *w***



Geometry problems also beg for you to draw a diagram (in the above problem, I draw rectangles); algebraic problems that you write out equations or inequalities, or simply keep careful track of variables and their definitions; data interpretation questions require careful note of parameters. Regardless of the area, the crux of this step is to write out everything that you know about the problem, and everything that you understand as *defined* within the problem. Without this effective ground, paying attention to the details of a problem is difficult if not impossible. (and make note of restrictive – and definitive – phrases, like 'must', 'can', 'cannot', etc)

SUBSTITUTE in any number of ways. First, look at everything you've defined, and then look at what you're aiming at (the point of the problem). Fundamentally, in thinking mathematically we are always trying to bring what we need closer to what we've got, to reduce the degrees of separation between the known and the unknown. Sometimes this means algebraic movement (letters that stand for concepts, or things, going from one equation to another), sometimes this means plugging in numbers (finding simple, sample solutions), and sometimes this means trying each of the answer choices as solutions, and eliminating while we find our bearings.

SIMPLIFY what you have left. Sometimes this means working an algebraic equation to completion (combining like-terms, bringing all your variables to one side and constants to the other, etc), sometimes it means reducing fractions, sometimes it means narrowing the field of possible answers through a logical approach to substitution.

The answer will always drop out, on its own, once we get everything else out of the way!

BACKDOOR SOLUTIONS
Keep in mind that the GRE is a timed test, however. While it is certainly possible that every problem may be solved so straightforwardly, practically the student under timed conditions must make use of alternative strategies. The time to use such strategy is 10 – 15 seconds after you've first started to write out what you know, in your SET-UP. If, in that time, you find that there are simply too many concepts that are misunderstood, or if you're confused about what the question is even asking, it's time to use an approach from the other end of the problem: begin plugging in solutions from your answer choices, beginning with choice 'C'.

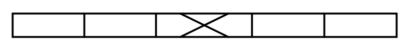
Why do we begin with choice 'C'? Because 'C' is in the middle of the list, always physically and often mathematically. Most often, answer choices are listed from either smallest to largest, or largest to smallest. If you approach the problem by plugging in choice 'C', you can most easily see implications in the rightness or wrongness of the answer. Is the choice too low? Then you can eliminate 'C' as well as the two choices below, 'A' and 'B'. Is it too high? Then you can eliminate 'C' along with 'D' and 'E'. Approaching the problem through the answers can often lead to insights that eluded you on first and even second read.

Another tactic to take is to find simple, sample solutions to make the hypothetical problem work in the real world, rather than the abstract world of alegrebra. For instance:

> If n is any integer, and o is any even integer, and e is any odd integer, which of the following cannot be odd?
>
> A. $2n + o$
> B. $n + o$
> C. $n^2 + o$
> D. $2n + e$
> E. $3n + e$

If you're anything like me, once I begin to use algebra on the above problem, my thoughts seem to run into a squishy road block, and my notes sort of dribble out, without much meaning. It's only after I begin to apply some practical numbers (and keep track of them neatly in my notes!) that the problem becomes awfully easy. In this case, I also have to begin with choices. As noted, I begin with 'C', and use 2 sample solutions for *n* (which can be any integer, so I choose two small ones, one odd and the other even: 2 and 3). The other restrictions, *o* is even and *e* is odd: 2 and 1. This is what my notes look like:

n	*o*	*i*
2	2	1
3	2	1



What I've done is keep track, like an accountant, of what I use. In the boxes on the side, I keep track of which choices I've eliminated. Often, plugging in just one or two choices gives me as much information as I need to clear up my misunderstanding, and find the correct answer.

Fundamentally in trying such strategies, the student is learning to find the ground of the problem, and keep everything out of the head. He/she is doing the work necessary to bring the unknown to the arena of the known. Again, it is helpful here to note all the work neatly on your scratch notes. I say neatly because what you write and how you write it is most reflective of what and how your understand. If you strive to be neat, you'll also strive for rigor. In short, the clearer and more complete your notes, the clearer your mind.

Ironically, taking such notes will SAVE you time on this exam, as long as you don't go overboard. Remember, the point is to act quickly and efficiently. Long, involved notes aren't advisable. But, short and effective notes keep you from running around in the Habitrail of your mind.

SUMMARY OF DIRECTIONS FOR DATA INTERPRETATION

The questions in this group refer to the data provided. For each question, select the best of the answer choices given.

DATA INTERPRETATION

More than any other section, perhaps, the Data Interpretation questions test your ability to simply pay attention. There are no backdoor solutions, because each problem asks that you take values directly from the graph(s).

1. **Familiarize yourself with the graph(s).**

You'll find that these questions are difficult only insofar as you've misunderstood or misread the graph. Get familiar with it at the very outset, before looking at the first question. There is no need to take any notes. Simply look it over for main elements.

2. **Begin working a solution only after reading each question completely.**

Questions will often appear difficult only until we understand what they're really asking. Note the main elements, and again ask yourself: what math principle is involved? This question is often the key to avoiding traps.

3. **Work your problems according to the S Method: Set-up, Substitute, and Simplify. Do no work or calculation until after looking at the answers.**

Pay close attention to the implications of your answer choices before you do any calculations. Incorrect answers often give wonderful clues to the correct one – and you will usually be able to narrow down your choices to only 2 or 3 after just a glance.

4. **Approximate wherever possible. Calculations are often unnecessary.**

While some questions might be phrased like difficult math problems, once you've pinpointed the main elements as part of your Set-up, you'll find that most have deceptively simple solutions.

SUMMARY DIRECTIONS FOR COMPARISON QUESTIONS

This question consists of two quantities, one in column A and one in column B. There may be additional information, centered above the two columns, that concerns one or both of the quantities. A symbol that appears in both columns represents the same thing in Column A as it does in Column B.

You are to compare the two quantities and decide whether:

The quantity in Column A is greater.
The quantity in Column B is greater.
The two quantities are equal.
The relationship cannot be determined from the information given.

Quantitative Comparison

For many students, the Quantitative Comparison (QC) sections can be the trickiest of all. The good news is that they are also among the best opportunities improve your scores. The math is not very complex, even among the most difficult problems – but their structure can throw off even the best math student, expecting to 'do math'.

I am almost embarrassed to admit that I taught an SAT course for three years before I truly understood the difference between the Problem Solving and the Quantitative Comparison sections. It is just this difference that makes these questions such a treasure trove of points for the student who pays attention – the difference between solving a problem and playing a game of logic.

1. **Read the information 'given'. It cannot be changed.**

Your task is to compare two columns, under certain conditions. The conditions are spelled out in the information 'given' just above the question. Read this information, and begin to think about its implications. These are the rules of the game.

Remember, you are not actually solving any problem in these questions; you are simply trying to *compare*.

2. **Put both columns into the same terms.**

If you approach these sections with an eye toward comparison, you'll see that comparison is impossibly difficult unless the two columns are in the same terms. You cannot compare apples with oranges, but instead must use the rules of the game to determine the qualities and extent of the columns' relationship.

It often helps to plug in simple numbers from the outset. Remember that numbers can be both positive and negative. For instance: how would you answer this problem?

Column A	Column B
X	- X

If you say 'A', then you've ignored all negative values for the variable 'X', as well as the '0'. The trick is to keep track of simple, sample solutions in a simple chart – and remember that unless the problem notes otherwise, variables can stand for any real number:

X	-X
1	-1
-1	1

The best way to approach these problems is to begin with the simplest number you know in order to make the rules work. In the case above, we're given no more information about the variable, other than the relationship between the two columns.

3. Try to prove 'D'

As best you can, try to find solutions that first establish, and then alter the relationship between the columns. This aim will help guide you through every problem, just as it did so simply in the above example. If we cannot disprove our original solution, but simply find the same relationship again and again, then we've succeeded in our solution. If we DO disprove our original solution, then we've succeeded. Either way, we'll find the correct answer. More than one answer always means that the answer is 'D'.

Critical Hints and Backdoor Solutions:

- If the columns only involve numbers, without variables, then answer choice 'D' can NEVER be correct.
- Plug in, and keep track of, sample solutions.

- Be sure to sample from both sides of the ‘0’, or in the case of only positive numbers, both odd and evens, as well as extremes. Again, stop sampling as soon as you’ve found more than one solution. The correct answer is ‘D’.

- Redraw your geometry, and ‘mine’ your diagrams for information. Make sure that you write out everything that you know – leave no assumption unturned.

- Watch out for typical QC traps:
    - ‘look-alike’ columns
    - misleading information
    - misleading diagrams
    - questions playing to common assumptions