

Math Study Skills

Active Study vs. Passive Study

Be **actively** involved in managing the learning process, the mathematics and your study time:

- Take responsibility for studying, recognizing what you do and don't know, and knowing how to get your Teacher to help you with what you don't know.
- Attend class every day, and take complete notes. Teachers formulate test questions based on material and examples covered in class as well as on those in the text; yes this means you should read your text.
- Be an active participant in the classroom. Get ahead in the book; try to work some of the problems before they are covered in class. Anticipate what the Teacher's next step will be.
- Ask questions in class! There are usually other students wanting to know the answers to the same questions you have.
- Go for extra help and ask questions. The Teacher will be pleased to see that you are interested, and you will be actively helping yourself.
- Good study habits throughout the year make it easier to study for tests. This skill is developed on a daily basis.
- Sleeping during class, regardless of what class you had prior to your math class, regardless of the time of day, regardless of how long you stayed up the night before finishing work that you probably should have completed earlier is not an excuse, nor is it conducive to your success. Actively listening, participating, taking notes, and asking questions is a good way to fight off sleep. If you engage your brain, you will invigorate your body.
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Studying Math is Different from Studying Other Subjects

- Math is learned by **doing** problems. Do the homework. (Reread the previous sentence. Repeat). The problems help you learn the formulas and techniques you do need to know, as well as improve your problem-solving prowess.
- A word of warning: Each class builds on the previous ones, all semester long. You must keep up with the Teacher: attend class, read the text, and do homework **every day**. Falling a day behind puts you at a disadvantage. Falling a week behind puts you in deep trouble. You are now successful only at setting yourself up for failure.
- A word of encouragement!/: Each class builds on the previous ones, all year long. You're always reviewing previous material as you do new material. Many of the ideas hang together. Identifying and learning the key concepts means you don't have to memorize as much.

Study Time

You may know a rule of thumb about math (and other) classes: at least 2 hours of study time per class hour. But this may not be enough! A BC calculus student has been known to push the ratio to 4 to 1.

- Take as much time as you need to do all the homework and to get complete understanding of the material.
- **Form a study group.** Meet once or twice a week (also use the phone). Go over problems you've had trouble with. Either someone else in the group will help you, or you will discover you're all stuck on the same problems. Then it's time to get help from your Teacher.
- The more challenging the material, the more time you should spend on it.

Problem Solving

Problem Solving (Homework and Tests)

- The higher the math class, the more types of problems: in earlier classes, problems often required just one step to find a solution. Increasingly, you will tackle problems which require several steps to solve them. Break these problems down into smaller pieces and solve each piece - divide and conquer! Inch by inch, it's a cinch. Mile by mile, it's a trial.
- Problem types:
 1. Problems testing memorization ("drill") (Unit Circle, Formulas, etc)
 2. Problems testing skills ("drill"),
 3. Problems requiring application of skills to familiar situations ("template" problems),
 4. Problems requiring application of skills to unfamiliar situations (**you** develop a strategy for a new problem type),
 5. Problems requiring that you extend the skills or theory you know before applying them to an **unfamiliar** situation.

In early courses, you solved problems of types 1, 2 and 3. By Algebra I and II, you expect to do mostly problems of types 2 and 3 and sometimes of type 4. Later courses, such as Precal and Cal, expect you to tackle more and more problems of types 3 and 4, and (eventually) of type 5. Each problem of types 4 or 5 usually requires you to use a multi-step approach, and may involve several different math skills and techniques.

- When you work problems on homework, *write out complete solutions, as if you were taking a test*. Practice as you are going to play the game. Don't just scratch out a few lines and check the answer in the back of the book. If your answer is not right, rework the problem; don't just do some mental gymnastics to convince yourself that you could get the correct answer. If you can't get the answer, get help.
- The practice you get doing homework and reviewing will make test problems easier to tackle. Think of Math as any other skill-based activity, such as . . . a sport. The homework is the practice. It is the single-most important aspect to how you perform; however, you don't get "credit" for having good practices. The Quizzes are like you scrimmages, a chance to see how well your practices have been going; a chance to test your skills in a lower-risk environment. The tests and exams are like the big game. This is where your preparation should pay off. This is where it all matters. There are no "do-overs" or extra points for great practices or scrimmage wins. This is also something you cannot "cram" for. Think about it, if you practice all night long, relentlessly, before a big game, you are not only going to be sore, but also tired, fatigued, and will likely not do well in the game. So it is with math. Believe me. Practice every day.

Tips on Problem Solving

- Apply the George Pólya's, the great problem-solving mathematician, four-step process:
 1. The first and most important step in solving a problem is to **understand the problem**, that is, identify exactly which quantity the problem is asking you to find or solve for (make sure you read the whole problem).
 2. Next you need to **devise a plan**, that is, identify which skills and techniques you have learned can be applied to solve the problem at hand.
 3. **Carry out the plan**.
 4. **Look back:** Does the answer you found seem reasonable? Also review the problem and method of solution so that you will be able to more easily recognize and solve a similar problem.
- Some problem-solving strategies: use one or more variables, complete a table, consider a special case, look for a pattern, guess and test, draw a picture or diagram, make a list, solve a simpler related problem, use reasoning, work backward, solve an equation, look for a formula, use coordinates.

"Word" Problems are Really "Applied" Problems: Where the Rubber Hits The Road (especially if it's a problem involving a car!!)

I know it seems unfair that English and Math should collide, but the real world (and future employers) demands that you be able to interpret a problem from a certain context and find the solution or solution process on your own. The term "word problem" has only negative connotations. It's better to think of them as "applied problems." These problems should be the **most interesting** ones to solve. Sometimes the "applied" problems don't appear very realistic, but that's usually because the corresponding real applied problems are too hard or complicated to solve at your current level. But at least you get an idea of how the math you are learning can help solve actual real-world problems. Also remember that the ones in your text are contrived for the learning process only, and therefore, have reasonable numbers. True "word problems" may contain some surprisingly hideous numbers where rounding errors must be avoided at all costs. This is why it is so important to work with exact rational numbers, rather than rounded decimal answers.

Solving an Applied Problem

- First convert the problem into mathematics. This step is (usually) the most challenging part of an applied problem. If possible, start by **drawing a picture**. **Label** it with all the quantities mentioned in the problem. If a quantity in the problem is not a fixed number, **name** it by a **variable**. **Identify** the goal of the problem. Then complete the conversion of the problem into math, i.e., find equations which describe relationships among the variables, and describe the goal of the problem mathematically.
 - Solve the math problem you have generated, using whatever skills and techniques you need (refer to the four-step process above).
 - As a final step, you should convert the answer of your math problem back into words, so that you have now solved the original applied problem.
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Studying for a Math Test

Everyday Study is a Big Part of Test Preparation

Good study habits throughout the year make it easier to study for tests.

- **Do** the homework when it is assigned, as soon as possible after the lesson. You cannot hope to cram 3 or 4 weeks worth of learning into a couple of days of study.
- **Reread and process** your notes into your own words as soon as possible after the lesson. Why else take notes?
- **On tests you have to solve problems on your own, without help from friends, teachers, notes, etc. You must stand (or sit as the case may be) and deliver on your own;** homework problems are the only way to get practice. As you do homework, make lists of formulas and techniques to use later when you study for tests. If you are fortunate enough to be given a review for a test, think of it as an opportunity to practice the test. If you have not sat and worked through the review in a single sitting without aid before the test, do not expect the results to be any different when the actual test comes around.
- Ask your Teacher questions as they arise; don't wait until the day or two before a test. The questions you ask right before a test should be to clear up minor details. Coming in for tutorials to start your homework or ask questions on the morning that the assignment is due, or the day of the Quiz or test is not the way to help yourself be successful. Completing the assignments on the day they are assigned not only reinforces the ideas, skills, and concepts more expediently, but it also gives you extra time to ask questions that arise out of your own, personal struggles to master the concept.

Studying for a Test (this should be a “half pad” run through, and not a marathon practice).

- **Start** by going over each section, reviewing your notes and checking that you can still do the homework problems (actually **work** the problems again, and again if necessary). Use the worked examples in the text and notes - cover up the solutions and work the problems yourself. Check your work against the solutions given.
- **You're not ready yet!** In the book, each problem appears at the end of the section in which you learned how to do that problem; on a test the problems from different sections are all together.

- Step back and ask yourself what kind of problems you have learned how to solve, what techniques of solution you have learned, and how to tell which techniques go with which problems.
- Try to explain out loud, in your own words, how each solution strategy is used (e.g. how to solve a quadratic equation). If you get confused during a test, you can mentally return the problem in your mind and reference your mental schema. Check your verbal explanations with a friend during a study session (it's more fun than talking to yourself!).
- Put yourself in a test-like situation: work problems from review sections at the end of chapters, and work old tests if you can find some. It's important to keep working problems the whole time you're studying.

□ Also:

- Start studying early. Several days to a week before the test (longer for the final), begin to allot time in your schedule to reviewing for the test.
- Get lots of sleep the night before the test. Math tests are easier when you are mentally sharp.

Taking a Math Test

Test-Taking Strategy Matters

Just as it is important to think about how you spend your study time (in addition to actually doing the studying), it is important to think about what strategies you will use when you take a test (in addition to actually doing the problems on the test). Good test-taking strategy can make a **big difference** to your grade!

Taking a Test

- First **look over** the entire test. You'll get a sense of its length. Try to identify those problems you definitely know how to do right away, and those you expect to have to think about.
- Do the problems in the order that suits **you!** Start with the problems that you know for sure you can do. This builds confidence and means you don't miss any sure points just because you run out of time. Then try the problems you think you can figure out; then finally try the ones you are least sure about.
- **Time** is of the essence - work as **quickly** and **continuously** as you can while still writing **legibly** and **showing all your** work in a logical, sequential format. If you get stuck on a problem, move on to another one - you can come back later.
- **Show all your work:** make it as easy as possible for the Teacher to see how much you **do** know. Try to write a well-reasoned solution. If your answer is incorrect, the Teacher will assign partial credit based on the work you show. For higher-level classes, the process is more important than the actual answer. By clearly showing all steps, you can receive “processing points” and won't necessarily miss the entire problem just because of a careless mistake.

- **Never** waste time erasing! Just draw a line through the work you want ignored and move on. You know have a record of your successful attempt at finding a solution that does not work. Not only does erasing waste precious time, but you may discover later that you erased something useful (and/or maybe worth partial credit if you cannot complete the problem). You are (usually) **not** required to fit your answer in the space provided - you can put your answer on another sheet to avoid needing to erase.
- In a multiple-step problem **outline** the steps before actually working the problem.
- **Don't** give up on a several-part problem just because you can't do the first part. Attempt the other part(s) - if the actual solution depends on the first part, at least explain how you **would** do it.
- Make sure you **read** the questions **carefully**, and do **all parts** of each problem.
- **Verify** your answers - does each answer make sense given the context of the problem?
- If you finish early, **check** every problem (that means **rework** everything from scratch).

Getting Assistance

When

Get help as **soon** as you need it. Don't wait until a test is near. The new material builds on the previous sections, so anything you don't understand now will make future material difficult to understand. If you are absent, take responsibility for finding out what you missed and making up any work, quizzes, or tests as soon as possible. Get the notes from a friend. Copy them and read them as well as the section in your book, and try to learn and comprehend as much as you can before you just come into your teacher's room empty handed, with no investment on your part. This is liable to frustrate you and your teacher, and will not yield the optimal results. Only YOU can provide the thinking and effort that will ultimately lead to YOUR success.

Use the Resources You Have Available

- **Ask** questions in class. You get help **and** stay actively involved in the class.
- **Read your textbook, read your text book, read your textbook.**
- **Google** the topic and research the plethora of websites out there explaining the topics.
- **View** posted videos.
- **Visit** the lunch and learn sessions. Teachers like to see students who want to help themselves.
- **Ask** friends, members of your study group, or anyone else who can help. The classmate who explains something to you learns just as much as you do, for he/she must think carefully about how to explain the particular concept or solution in a clear way. So don't be reluctant to ask a classmate.
- **All** students need help at some point, so be sure to get the help **you** need.

Asking Questions

Don't be afraid to ask questions. **Any** question is better than no question at all (at least your Teacher/tutor will know you are confused). But a **good question** will allow your helper to quickly identify exactly **what** you don't understand.

- Not too helpful comment: "I don't understand this section." The best you can expect in reply to such a remark is a brief review of the section, and this will likely overlook the particular thing(s) which you don't understand.
- Good comment: "I don't understand why $f(x + h)$ doesn't equal $f(x) + f(h)$." This is a very specific remark that will get a very specific response and hopefully clear up your difficulty.
- Good question: "How can you tell the difference between the equation of a circle and the equation of a line?"
- Okay question: "How do you do #17?"
- Better question: "Can you show me how to set up #17?" (the Teacher can let you try to finish the problem on your own), or "This is how I tried to do #17. What went wrong?" The focus of attention is on **your** thought process.
- Right after you get help with a problem, work another similar problem by yourself.

You Control the Help You Get

Helpers should be **coaches**, not crutches. They should encourage you, give you hints as you need them, and sometimes show you how to do problems. But they should **not**, nor be expected to, actually do the work **you** need to do. They are there to help you figure out how to learn math for **yourself**.

- When you go for extra help, your study group, or a tutor, have a specific list of questions prepared in advance. **You** should run the session as much as possible.
- Do not allow yourself to become dependent on a tutor or a helper. This person cannot take the exams for you. You must take care to be the one in control of tutoring sessions.
- You must recognize that sometimes you do need some coaching to help you through, and it is up to you to seek out that coaching.