

# Strengthening Your Math Study Skills

## I. Studying Algebra

### Previewing Material

Before you attend your next class, use your textbook to preview the material that the instructor will be covering. First, skim the sections to be covered, look at the headings, and try to guess what the sections will be about. Then read over the material carefully.

You will find that when you read the material before you go to class, you will be able to follow the instructor more easily, things will make more sense, and you will learn the material more quickly. If there was something you did not understand when you were previewing the material, you can ask about it as the instructor is teaching it and thus get your questions answered before you begin to work on the assignment.

### Attending Class

Always attend class! Getting the notes from someone else is not the same as being there yourself. And be sure to be on time. Always be an active participant: think, question, write, interact. It is important that you make yourself aware of :

your instructor's name, office hours, and a number where s/he can be reached

the course objectives, syllabus, calendar, textbook, and any supplemental materials

the testing procedures, format, and grading scale

the point values for assignments, quizzes, attendance, and exams

other resources available (study groups, tutors, The Learning Center, study guides, etc.)

### Taking Notes in Math Classes

1. Write down what is on the board; identify the problem and page numbers.
2. Write down the explanation that goes with what is on the board. Write a reason for each step of the problem.
3. If there is no time to write an explanation, leave blank spaces and fill them in within 24 hours.
4. Do not jam numbers or symbols together; give yourself plenty of space.

Examples:  $\frac{1}{2}$     $\frac{1}{4}$

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5. Make each numeral and letter clear and unique so as not to confuse them.  
Examples: 1 (numeral) and l (lower case L) 2 and Z 5 and S
6. Identify and highlight main topics. Keep note cards with formulas and definitions for each chapter.
7. Draw pictures, diagrams, charts, etc. to make your work clearer.
8. Take good notes for assignments and tests coming up. Keep a record of all scores received during the semester.
9. Read and revise your notes within 24 hours (do not recopy them).
10. Label your notes with the date, chapter, and page numbers.
11. Keep your notes as organized as possible. Do not be afraid to use paper. Use the margins only to highlight important points. Any time an instructor repeats a point, be sure to highlight that point in your notes.

### Studying Properly

In most college courses, you are expected to spend between two and four hours studying outside of class for every hour spent in class.

It is especially important that you spend this much time on your algebra course, since you must both acquire and then perfect various skills; and, as those of you who play a musical instrument or participate seriously in athletics already know, it takes time and lots of practice to acquire and then perfect a skill.

It also is important that you distribute your study time. That is, do not try to do all your studying on one, two, or even three days of the week and then skip studying the other days. You will find that understanding algebra and acquiring the necessary skills are much easier if you spread your studying out over the entire week, doing a little each day. If you study in this way, you will find you need less time to get ready for exams.

In addition, if your study sessions are more than one hour long, it is a good idea to take a ten-minute break after every fifty to sixty minutes of study. Such breaks serve to refresh your mind and help you to think more clearly.

### What to Do First . . .

Before you attempt your algebra problems, it is important that you first review the relevant portions of your notes.

Simply memorizing a bunch of seemingly unrelated algebraic steps from an example in your notes or textbook may seem to work for you initially, but fairly soon your memory will be overburdened and you will begin to confuse examples and /or forget steps.

Reviewing the material before doing your homework problems makes each solution you go through more meaningful. The better you understand the concepts underlying the exercises, the easier the material becomes, and the less likely you are to confuse examples or forget steps.

When reviewing the material, take the time to *think* about what you are reading. Ask yourself:

- How do these concepts relate to previous concepts?
- How do the examples illustrate these concepts?

### Doing Exercises

After you have finished reviewing the appropriate material, you should be ready to do the exercises. Although your ultimate goal is to be able to work out the exercises accurately and quickly, do not worry about speed at this point. Instead, take your time and think carefully about what you are doing.

Think about how the exercises illustrate the concepts you have just studied. Think about the steps you are taking and ask yourself why you are proceeding in this particular way and not in some other. Ask: Why am I using this particular technique or step rather than a different one?

By taking time to think about what you are doing, the material will become more understandable to you and easier to remember. You will be less likely to "do the wrong thing" in an exercise because you now have an understanding of what you are doing.

Once you believe you thoroughly understand what you are doing and why, you will then want to work on increasing your speed. You'll probably find, however, that as your understanding has grown, your speed in doing the exercises also has grown.

### Reading Directions

One important but frequently overlooked part of an algebraic problem is the instructions. Sometimes the instructions are given in a single word, such as "simplify" or "solve"; other times, it takes longer to understand the instructions than it does to do the exercise! The instructions tell us what we are expected to do, so make sure you read the instructions carefully and understand what you are being asked to do.

Sometimes, two examples look the same, but have different instructions. For instance:

*Identify this property*  $a + (b + c) = (a + b) + c$

versus

*Verify this property by replacing the variables with numbers:*  $a + (b + c) = (a + b) + c$

Always look at a problem carefully and ask yourself what is being asked and what needs to be done -- before you do it!

### **Comparing and Contrasting Examples**

When learning something for the first time, it is easy to get confused and treat things which really are different as though they are the same simply because they look similar. Algebraic notation can be especially confusing in this respect because of the detail involved. Move or change one symbol in an expression and the entire example is different: change one word in a word problem and the whole problem has a new meaning.

It is important that you learn to notice these subtle differences. The best way to do this is by comparing and contrasting concepts and examples that look almost identical, but really are not. For example, the two expressions  $3 + 2 \cdot 4$  and  $3 \cdot 2 + 4$  look similar, but actually are very different.

When you are reading about a concept or working out exercises, ask yourself:

- What concepts or examples are similar to those which I am now doing?
- In what ways are they similar?
- How do I recognize the differences?

Doing this will help to prevent you from making careless errors later on.

### **Coping with Getting Stuck**

All of us have had the frustrating experience of getting stuck on a problem; sometimes even the simple problems can give us difficulty.

Perhaps you do not know how to begin; or maybe you are stuck halfway through the exercise and are at a loss as to how to continue; or possibly your answer and the book's answer do not seem to match. (In the last instance, do not assume the book's solutions are 100% correct, but do be sure that you have copied the problem accurately!)

Assuming you have reviewed all the relevant material beforehand, be sure you have spent enough time on the problem. Some people take one look at a problem and simply give up without investing much time or thought. This is not what we regard as "getting stuck"; rather it is giving up before having even started!

If you find after a reasonable amount of time, effort, and thought, that you are still not getting anywhere, look back through your notes and textbook for help or try to find exercises that are similar to the one you are stuck on and that you are able to do. Analyze what you did to arrive at the solution to these similar exercises and try to apply the same principles to the problem you are finding difficult. If you have difficulty with similar problems as well, you may have missed something in your notes or in the textbook. Reread the material and try again. If you still are not successful, try moving on to different problems or taking a break and coming back to the difficult problem later. Often it helps to get a good night's sleep and try the problem again on the next day.

At some point, it becomes prudent to visit The Learning Center to get help with problems that are causing difficulty. Bring your own attempts on these problems so the tutors are able to see just where the difficulties lie.

## Reviewing Old Material

One of the most difficult aspects of learning algebra is that each skill and concept depends on those previously learned. If you have not acquired a certain skill or learned a particular concept well, this will adversely affect your ability to learn the next skill or concept. Thus, even as you continue to learn new subject matter you should be constantly reviewing previous material in order to ensure that you have learned it well. You will be surprised to find how much constant reviewing aids you in learning new material.

Reviewing also helps to give you a better perspective on material you have covered. It helps you tie different topics together, and that makes all of them more meaningful. Some statement you read three weeks ago, and which may have seemed very abstract then, suddenly becomes simple and obvious in the light of all you now know.

Since many problems require you to draw on skills you have developed previously, reviewing also is important to prevent forgetting or confusing those skills.

When working the exercises, always try to work out some exercises from earlier chapters or sections. Try to include some review exercises at every homework session. Take the time to reread the text material in previous chapters. When you review, think about how the material you are reviewing relates to the topic you are presently studying.

## Reflecting

When you have finished reading or doing examples, it is always a good idea to take a few minutes to **think** about what you have just done. Think about how the examples relate to the written material, and how both relate to what you have learned previously. How are the examples and concepts you have just covered similar to or different from those you have already learned?

## Checking Your Work

We develop confidence in what we do by knowing that we are right. One way to check to see if we are right is to look at the answers provided in the back of the book. But remember, answers are not provided during exams, when we need confidence the most! It is frustrating to find that you incorrectly worked a problem on an exam, and then discover that you would easily have seen your error had you just taken the time to check your work. Therefore, you should know how to check your answers.

The method of checking work should be different from the method used in the solution process. In this way you are more likely to discover any errors you might have made. If you simply rework the problem in the same way, you cannot be sure you have not made the same mistake both times.

Ideally, the checking method should be quicker than the method for solving the problem (although this is not always possible).

### Making Study Cards

Study cards are 3" x 5" or 5" x 8" index cards that contain summary information needed for convenient review. The process of making study cards is a learning experience in itself. We will discuss using study cards later. We will cover three types of cards: the definition/principle card, the warning card, and the quiz card.

Definition/principle (D/P) cards contain a single definition, concept, or rule for a particular topic.

The front of each D/P card should contain: a heading of a few words; the definition, concept, or rule accurately recorded; and, if possible, a restatement of the definition, concept, or rule in your own words. The back of the card should contain examples illustrating the idea on the front of the card.

Sample D/P card:

FRONT

Distributive Property  
 $a(b+c) = ab + ac$   
 multiply each term  
 by a

BACK

$$3x(x+2y) = 3x \cdot x + 3x \cdot 2y$$

$$= 3x^2 + 6xy$$

$$-2x(3x-y) = -2x \cdot 3x - 2x \cdot (-y)$$

$$= -6x^2 + 2xy$$

Warning (W) cards alert you to errors that you may be making consistently on homework, quizzes, or exams, or those common errors pointed out by your teacher or your text. The front of the warning card should contain the word WARNING and the warning itself; the back of the card should contain an example of both the correct way an example should be done and the common error. Be sure to label clearly which solution is correct and which is not.

Sample W card:

FRONT

Warning:  
 An exponent refers only to the factor immediately to the left of the exponent.

BACK

$$2 \cdot 3^2 = 2 \cdot 3 \cdot 3$$

NOT  $(2 \cdot 3) \cdot (2 \cdot 3)$

$$(-3)^2 = (-3) \cdot (-3) = 9$$

BUT

$$-3^2 = -3 \cdot 3 = -9$$

Quiz (Q) cards will be used to construct practice tests. To make Q cards, pick out a few odd-numbered exercises from each section of your text, putting one problem on one side of each card. Make sure that you copy accurately both the instructions and the problem. On the back of the card, write down the exercise number and the section of the book where the problem was found; also write down the correct answer to the problem.

Sample Q card:

FRONT

Simplify the expression  
as completely as possible  
 $3m - 4m - 5m$

BACK

1.5 #9  
 $-6m$

## II. Preparing for an Exam

### Is Doing Homework Enough?

At some point you will be required to take an algebra exam. More than likely, your time will be limited and you will not be allowed to refer to any books or notes during the test.

Working problems at home will help you develop your skills and better understand the material, but there is still no guarantee that you can demonstrate the same high level of performance during a test that you may be showing on your homework. There are several reasons for this:

1. Unlike homework, exams must be completed during a limited time.
2. The fact that you are being assigned a grade may make you anxious and more prone to careless errors.
3. Homework usually covers a limited amount of material, while exams usually cover much more material. This increases the chance of confusing or forgetting skills, concepts, and rules.
4. Your books and notes are available as a guide while working homework exercises, but not while taking most exams.

Even if you do not look at your textbook or notes while working on homework exercises, the fact that you know what sections the exercises are from, and what your last lecture was about, cues you in on how the exercises are to be solved. You may not realize how much you depend on these cues, and you may find yourself at a loss when an exam does not provide them for you.

If you believe that you understand the material and you are doing well on your homework, but your exam grades just do not seem to be as high as you think they should be, then the thoughts that follow on preparing for exams should be helpful.

### When to Study

Knowing when to start studying for exams and how to distribute your study time is important. To begin with, "all-nighters" (all night study sessions just prior to an exam) seldom work. As with athletic or musical skills, algebraic skills cannot be developed overnight. In addition, without an adequate amount of rest, you will not have the clear head you need to work on an algebra exam. It is usually best to start studying early -- about two weeks before the exam. In this way you have the time to perfect your skills and, if you run into a problem, you can consult your teacher to get an answer in time to include it as part of your studying.

It is also a good idea to distribute your study sessions over a period of time. That is, instead of putting in six hours in one day and none the next two days, put in two hours each day over the next three days. You will find that not only will your studying be less burdensome, but also you will retain more with less effort.

As mentioned before, your study activity should be varied during a study session. It is also a good idea to take short breaks and relax. A study "hour" could consist of fifty minutes of study and a ten-minute break.

### Study Activities

If you are going to learn algebra well enough to demonstrate high levels of performance on exams, then you must concern yourself with both developing your skills in algebraic manipulation and understanding what you are doing.

Many students concentrate only on algebraic skills. They often resort to simply memorizing the procedures for algebraic manipulations. This may work for quizzes or for a test covering just a few topics, but for exams covering a chapter or more, this can be quite a strain on the memory. Eventually interference occurs and memorized problems and procedures get confused with one another. If you find yourself doing well on quizzes but not on longer exams, this may be your problem.

Concentrating on understanding what a method is and why it works is important. Neither the instructor nor the textbook can cover every possible way in which a particular concept may present itself in a problem. If you understand the concept, you should be able to recognize it in any problem. But of course if you concentrate only on understanding concepts and not on developing skills, you may find yourself prone to making careless and costly errors under the pressure of an exam.

In order to achieve both skill development and conceptual understanding, your studying should include four activities:

1. Practicing problems
2. Reviewing your notes and textbook
3. Drilling with study cards
4. Reflecting on the material and exercises

Rather than doing any one of these activities over a long period of time, it is best to do a little of each of the first three activities during a study session and then conclude the session by reflecting on what was studied.

### **Drilling With Study Cards**

Study cards (see Making Study Cards above) are convenient to use -- you can carry them along with you and use them for review in between classes or as you wait for a bus.

Use the D/P and W cards as follows:

1. Look at the heading of each card and cover the rest of the card. See if you can remember what the rest of the card says.
2. Pull out the cards you know well and put them aside. Review these cards occasionally.
3. Study repeatedly the cards you do not yet know. Shuffle the cards occasionally so as to change the order in which you are viewing them.
4. As you go through your cards, ask yourself the following questions:
  - When do I use this rule, method, or principle?
  - What are some examples of the definitions or concepts?

Use the Q cards to practice your algebra skills. As you move through the cards and solve the various problems, ask yourself questions like these:

- What concept is illustrated by this problem?
- Why does this solution process work?
- Is there a way to check this problem?
- What are the differences and similarities between various problems?

### **Reviewing Your Notes and Text; Reflecting**

An important facet of studying for exams is reviewing your notes and text. Your notes are a summary of the information you believed was important at the time you wrote them down. In the process of reviewing your notes and text, you may turn up something you missed. A gap in your understanding may get filled, giving more meaning to some of the definitions, rules, and concepts on your study cards (and thereby making them easier to remember!). Perhaps you will understand a shortcut that you missed the first time around.

Reviewing the explanations and problems in the text and in your notes gives you a better perspective and helps tie the material together. Concepts will begin to make more sense when you review them and think about how they are interrelated. It also is important to practice review problems so you will not forget skills you have already learned. Do not forget to review old homework exercises, quizzes, and exams, focusing especially on those problems that were done incorrectly.

It also is important to reflect on the material you are reading and the exercises you are doing. Your thinking time is usually limited during an exam, and you want to be able to anticipate variations in problems and to make sure that careless errors are minimized. For this reason it is a good idea to try to think about possible problems ahead of time. In areas where you tend to get confused, make the distinctions that exist as clear as possible.

### **Preparing a Sample Exam**

It is important that you find out how well you know the material before you get the real test into your hands. Make up a practice exam for yourself and take it without using any of your "crutches"-books, notes, study cards, other people, etc. This is the best judge of your knowledge and skill.

A few days before the exam, select an appropriate number of problems from your Q cards, old exams, or old quizzes to make up this practice test for yourself. You may need the advice of your teacher as to the number of problems and the amount of time to allow for the test. Think about what concepts have been covered and emphasized and make your test accordingly.

Now find a quiet, well-lit place with no distractions, set your clock for the appropriate time limit (the same as your class exam will be) and take the test. Pretend it is a real test; that is, do not leave your seat or look at your notes, books, or answers until your time is up.

When your time is up, stop; you may now look up the answers and grade yourself. If you are making errors, check over what you are doing wrong. Find the section where those problem types are covered, review the material, and try more problems of that type.

If you do not finish your practice test on time, you should definitely work on your speed. Remember that speed, as well as accuracy, is important on most exams.

Think about what you were doing as you took your test. You may want to change your test-taking strategy or read the suggestions below on taking exams. If you were not satisfied with your performance and you have time after further review, give yourself another practice test.

### III. Taking an Exam

#### **Just Before the Exam**

You will need to concentrate and think clearly during the exam. For this reason it is important that you get plenty of rest the night before the exam and have adequate nourishment.

It is not a good idea to study up until the last possible moment. You may find something that you missed and become anxious because there is not enough time to learn it. Then, rather than simply missing a problem or two on the exam, the anxiety may affect your performance on the entire exam. It is better to stop studying some time before the exam and do something else. You could, however, review formulas you need to remember and your *W* cards just before the exam.

#### **Beginning the Exam**

Be sure to give yourself plenty of time to get to the exam. At the exam, make sure you listen carefully to the instructions. Read carefully any written instructions.

As soon as you are allowed to begin, jot down the formulas you think you might need, and write some key words (warnings) to remind you to avoid common errors or errors you have made previously. Writing down the formulas first will relieve you of the burden of worrying about whether you will remember them when you need to, thus allowing you to concentrate more.

You should refer back to the relevant warnings as you go through the exam to make sure you avoid these errors.

#### **What to Do First**

Not all exams have the problems arranged in ascending order of difficulty (from easiest to most difficult). Since time is usually an important factor, you do not want to spend so much time on problems you find difficult that you do not have enough time to do the ones that are easier for you. Therefore, it is strongly recommended that you first look over the exam and then proceed in the following order:

1. Start with the problems that you know how to solve quickly.
2. Then go back and work on problems that you know how to solve but that take longer.
3. Then work on those problems that you find more difficult, but for which you have a general idea of how to proceed.
4. Finally, divide the remaining time between doing the problems you find most difficult and checking your solutions to the problems you've already completed. Do not forget to check the warnings you wrote down for yourself at the beginning of the exam.

You probably should not spend a lot of time on any single problem. To determine the average amount of time you should be spending on a problem, divide the amount of

time given for the exam by the number of problems on the exam. For example, if the exam lasts for 50 minutes and there are 20 problems, you should spend an average of  $50/20 = 2\frac{1}{2}$  minutes per problem. Remember, this is just an estimate. You should spend less time on "quick" problems (or those worth fewer points), and more time on the more difficult problems (or those worth more points). As you work the problems be aware of the time; if half the time is gone you should have completed about half the exam.

### **Dealing with Panic**

If you followed carefully the advice given thus far, you should feel fairly confident and less anxious about the exam. But you may still find during the course of the exam that you suddenly are stuck or are "drawing a blank." This may lead you to panic and say irrational things like, "I'm stuck... I can't do this problem. . . I can't do any of these problems. . . I'm going to fail this test." Your heart may start to beat faster and your breath may quicken. You are entering a panic cycle (typically known as math anxiety).

These statements are irrational. Getting stuck on a few problems does not mean that you cannot do any algebra. These statements only serve to interfere with concentrating on the exam itself. How can you think about solving a problem while telling yourself that you are unable to do it?

What you need to do is break the panic cycle. What we recommend is that you put aside the exam and silently say to yourself **STOP!** Then try to relax, clear your mind, and encourage yourself by saying to yourself things such as "This is only one (or a few) problems, not the whole test" or "I've done problems like this before, so I'll get the solution soon."

Now take several slow deep breaths and search for some problems that you know how to do and start with those. Build your concentration and confidence slowly with more problems. When you are through with the problems you can complete, go back to the ones you were stuck on. If you have time, take a few minutes and rest your head on your desk, and then try again. But do be sure to save some time for checking your work on the problems you have been able to complete.

## Concluding Comments About Exams

Do not forget to check your work as we have suggested several times. Reread all directions and make sure that you have answered all the questions as directed.

If you are required to show your work (such as for partial credit), make sure that your work is neat. Do not forget to put your final answers where directed or at least indicate your answers clearly by putting a box or circle around them. For multiple-choice tests be sure you have filled in the correct space.

One other bit of advice: Some students are unnerved when they see others finishing the exam early. They begin to believe that there may be something wrong with themselves because they are still working on the exam. You should not be concerned that some students can do the work quickly and others leave the exam early, not because the exam was easy for them, but because they gave up.

In any case, do not be in a hurry to leave the exam. If you are given one hour for the exam then take the entire hour. If you have already checked all your work and you still have time left over, relax for a few minutes and then go back and check your work again.

## IV. Reviewing Your Exam

### Diagnosing Your Strengths and Weaknesses

Your exam is a useful tool in helping you to determine what topics, skills, or concepts you need to work on in preparation for the next topic or in preparation for future exams. After you get your exam back, you should review it carefully: examine both what you did correctly and where you made mistakes.

Don't gloss over your errors, assuming that they were all "minor" or merely due to "carelessness." Students often mistakenly label many of their errors as "careless," when in fact the errors really are a result of not clearly understanding certain concepts or procedures. Be honest with yourself. Don't delude yourself into thinking that all your errors are simply the result of carelessness. Ask yourself the following questions about your errors:

- Did I understand and follow the directions?
- Did I understand the topic that the problem is testing?
- Did I misuse a rule or property?
- Did I make an arithmetic error?

Look over the entire exam. Did you consistently make the same type of error throughout the exam? Did you consistently miss problems covering a particular topic or concept? You should try to follow your work on the exam and understand just what you were doing. If you think you have a problem understanding a concept, topic, or approach to a problem, you should immediately seek help from your notes, your text, or your teacher.

**Checking Your Understanding**

After you have studied your exam and you believe that you understand the material and what you did wrong, then do the following: Copy the problems onto a clean sheet of paper and rework them without your text, notes, or exam. When you are finished, check to see if your answers are correct. If they are, then try to find problems in the text that are similar and work these new problems on a clean sheet of paper (again without notes, text, or exam). If some of your answers to the new problems are incorrect then you may simply have learned how to solve the test problems without really understanding the topic that those problems were testing. In that case, you may need to repeat these steps several times until you are confident you really understand your errors.

Analyze your study techniques and your test-taking techniques. If you are not happy with your grade, then you need to make some changes. *Don't keep doing what you've been doing if you don't want to keep getting what you've been getting.*

In any case, you should keep your exam (with the correct answers) since it is a good source of information for future study. You may want to record on W cards the errors that you consistently made on the exam. Also, different exam problems can be used on your Q cards.

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