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**Concepts in Mathematics
By David Alderoty © 2015**

**Chapter 1) Strategies for Studying and Learning Mathematics, and Internet Resources For Mastering Mathematics
Over 2540 Words**

**To contact the author left click for a website communication form, or use:
David@TechForText.com**

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To Access Additional Information with Hyperlinks

After I complete a writing task, I select a number of websites from other authors, and link to them, to provide additional information and alternative perspectives for the reader. The links are the blue underlined words, and they can be seen throughout this book. The in-line links, such as the link on these words, are primarily to support the material I wrote, or to provide additional details. The links presented at the end of some of the paragraphs, subsections, and sections are primarily for websites with additional information, or alternative points of view, or to

support the material I wrote. The websites contain articles, videos, and other useful material.

The brown text that look like these fonts, represent quotes in this e-book. **You can access the original source, by clicking on a link presented just before a quote.**

If a link fails, use the blue underlined words as a search phrase, with www.Google.com. If the failed link is for a video use www.google.com/videohp. The search will usually bring up the original website, or one or more good alternatives.

Studying and Learning Mathematics, and Related Concepts

Studying and Learning Mathematics

There are four important strategies for understanding, studying, and learning mathematics, which are as follows:

1) Using the proper strategy for **Reading and Comprehending Mathematics**

2) Adequate **Preparation for Mathematics Courses**

3) Mathematics is a skill that requires **Practice, Practice, and More Practice**

4) Developing an understanding that **Mathematics is NOT a Set of Rules, it is a Set of Definitions, Postulates, Theorems, Formulas, and Techniques, Based on LOGIC**

Without the four strategies mentioned above, most students will have difficulties with mathematics courses, especially at the college and graduate level. These strategies are discussed in the following four subsections.

<u>Reading and Comprehending Mathematics</u>

Mathematical material cannot be read, comprehended, memorized, or mastered in the same way that other subjects can be learned. One page of mathematics may require more time and effort to master than one or two chapters of conventional course work, such as sociology, history, or English literature. With most course material, you are **not** practicing an actual skill that requires complex sets of logical steps, unless the course is based on mathematics.

When students initially fail to master a topic in other subjects, they can usually learn the material by reading a textbook. However, this is **not** the case with mathematics. Most textbooks on mathematics are written with the assumption that the student will learn the material step-by-step from an instructor.

<u>The only practical way of learning and comprehending mathematics is with extensive practice, COUPLED with the assistance of instructors, tutors, and/or videos.</u> This can be reinforced with other techniques, such as <u>computerized tutorials</u>, and <u>trial and error learning</u>, and studying text-based material on mathematics. Ideally, all of the above should be incorporated into your personal study plans, to optimize your success in mathematics.

When students do **not** understand the ideas presented above, they may erroneously conclude that they do **not** have an inborn ability to master mathematics. This notion might be easily reinforced if the student failed a mathematics course, or even if he or she quickly read a couple of pages from a math textbook. As a result, they may change their major, to an area that does not involve mathematics.

Adequate Preparation for Mathematics Courses

Most mathematics courses start with the assumption that the student has achieved a specific level of mathematical knowledge and skills. For example, a college-level course on algebra might be created for students that already have substantial skills and knowledge in algebra and trigonometry from their studies in high school. If this is **not** the case, the student is likely to fail the course, or have an excessively difficult time obtaining a passing grade.

A solution to the problem described above, is to evaluate the content of a mathematics course before registering. If you have not acquired the knowledge and skills to **do well** in the course, take a simpler course first. This can sometimes involve a preparation course in mathematics, which many colleges provide.

Some students might be able to prepare themselves for a mathematics course, with self-study based on mathematics videos. This is especially useful for people that already have a

background in mathematics, or for individuals that are planning to take a course for reviewing a topic in mathematics.

Practice, Practice, and More Practice

A major part of learning mathematics is practice, and without practice, it is unlikely that most students could pass a mathematics course. There are two very important reasons why practice is necessary with mathematics. First, mathematics is a skill, and to develop any skill requires practice.

The second reason is it is difficult to convey mathematical techniques and concepts in words. As a result, mathematics usually requires at least some **trial-and-error learning**, which takes place when students try to solve math problems. This can indicate if you fully understand the techniques and concepts that were explained to you by your instructor. The trial and error learning frequently results in developing optimized problem-solving strategies in mathematics.

Mathematics is NOT a Set of Rules, it is a Set of Definitions, Postulates, Theorems, Formulas, and Techniques, Based on LOGIC

Many students, instructors, and some sources, describe mathematics as a set of rules. To solve a specific type of problem, you follow a specific set of rules, and related steps. This is an **oversimplified** way of learning mathematics, and it

can be <u>**dysfunctional**, especially for students that are majoring in subjects that involve mathematics.</u>

To master mathematics, it is necessary to understand the difference between rules, and the logical definitions, postulates, theorems, formulas, and techniques that comprise mathematics. This is explained in the following two paragraphs.

<u>Rules</u> can be based on values, practical utility, and/or on arbitrary beliefs or traditions. Rules cannot be evaluated to determine if they are right or wrong, but they can be evaluated in terms of good or bad, or in terms of functionality or dysfunctionality. You cannot use logic to create your own rules, to solve your problems, unless the rules relate to your household or personal space.

<u>The definitions, postulates, theorems, formulas, algorithms, and techniques that comprise mathematics</u>, cannot be evaluated in terms of our values, or in terms of good or bad. They can be evaluated in terms of true or false, or in terms of their utility for solving specific types of problems. Unlike rules, you can use logic to derive your own theorems, formulas, and techniques to solve math problems. In mathematics, if you do not know how to solve a problem, you can probably devise your own technique to obtain a solution.

If you think of axioms and theorems as rules, you lose the versatility, and the creativity that mathematics offers. Instead of a system of logic that can be used to solve many problems,

mathematics becomes a meaningless and uninteresting game, with a complex set of tedious rules.

If you learn mathematics in terms of a blind set of rules, you are likely to forget what you learned. If you learn mathematics in terms of postulates, theorems, and **logic**, any material you forget, you can probably re-create it, based on logical concepts.

==**It is not necessary to learn the name of every postulate, and the derivation of every theorem. However, it is necessary to develop an understanding of the logic behind every step you use to solve a math problem. You should develop an understanding of what you are doing in terms of logic that relates to each problem you solve. All of this ultimate leads to an intuitive insight, based on mathematical logic.**==

If you can devise an alternative set of steps to solve a math problem, you have developed the ability discussed above.   For example, how many ways can you solve the following division problem:

$$\frac{990}{330} =$$

There are at least three ways to solve the above problem.

==**Internet Resources For Learning Mathematics**==

Note this Section Provides Useful Links to Web-Based Resources for Learning Mathematics, but Carry Out Your Own Web-Based Searches for Additional Information

This section provides general information, about web-based resources for learning mathematics. This includes many links to websites and search engines to access resources. This should give you a good idea of what material is available on the web. However, you should carry out your own web-based searches to find the specific resources you need to study mathematics.

Six Categories of Web-Based Resources for Studying, Practicing, and Learning Mathematics

Many websites provide resources to help students learn mathematics. Most, but **not** all of these resources are free. The resources available on the web can be divided into the following six categories. (Note the blue underlined words are links to Internet searches or to specific websites):

1) VIDEOS ON MATHEMATICS: See also Mathematics Courses, and Advanced Mathematics Courses

2) MATHEMATICS PROBLEMS TO SOLVE FOR PRACTICE, see also Solving math problems for practice, and Mathematics problems and solutions

3) ARTICLES, AND TEXT BASED INSTRUCTIONS ON MATHEMATICS, see also International Journal for Mathematics Teaching and Learning

4) ONLINE CALCULATION DEVICES, see also "Online Calculators "

5) MATHEMATICS SOFTWARE DOWNLOADS, see also free mathematics software downloads and "Microsoft Mathematics" and Microsoft Mathematics Add-In for Word and OneNote

6) MATHEMATICS TUTORIAL SOFTWARE, see also Mathematics tutorial software download Programmed learning for mathematics

There may be some overlap between the above categories, which depends on the design of the specific web resource. There are **many** additional links to these resources in the following subsections.

The best web-based resources to learn mathematics are VIDEOS, combined with, MATHEMATICS PROBLEMS TO SOLVE FOR PRACTICE. This is presented in the following subsections.

Videos for Learning Mathematics

It is **not** feasible for most people to learn mathematics solely by reading instructional material. Most students need an instructor to learn mathematics. Many math **videos** provide video-based mathematics instructors, without charge. This is an excellent way to learn mathematics. Unlike conventional instructors, a video can be watched at your convenience, and repeated if necessary. A video can be stopped at any point in time, such as to solve a problem that the instructor just explained. If you do

not understand a concept presented by an instructor, you can consult another video.

Of course, **videos do not provide all of the advantages of working with a live instructor**. However, it eliminates all the disadvantages associated with conventional mathematics instructors. Some students might prefer to include a personal tutor, along with the videos, which is probably the ideal. This can be expensive, unless there are free math tutors available at the school you are attending. However, most students can probably master most mathematical material solely with videos, coupled with determination and practice.

The following subsection provides important instructions for using videos optimally, for learning mathematics.

How to Use Video Optimally to Learn Mathematics

To use videos optimally, you should learn how to stop the video at any point, such as to practice what the instructor presented, to be sure that you understand the material, or to take a break. To do this with most videos, you simply left click on the video, such as in the center of the screen. To restart the video, simply left click again in the center of the screen.

You should also learn how to repeat a section of a video, without replaying all of it. This can usually be done by first stopping the video, by left clicking on it. Then, on the bottom of the screen, there is usually a bar with a knob. In the screenshot

below, the bar is red, and the knob is white. Place the mouse cruiser on the white circle, and left click, and hold down the mouse key, and move the knob to the left. (If you let go of the mouse key, the knob will **not** move.) If you want to turn back a video a minute or less, the required knob movement, will be relatively small. For longer time intervals, the movement will be further to the left. You also can move the video forward using the technique described above, except you move the white knob to the right.
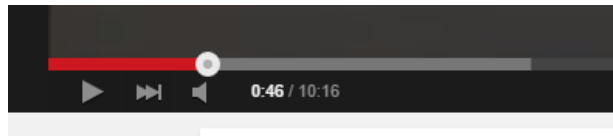
When studying math with videos, you must practice solving problems. The more problems you solve, the more successful you will be. The problems you solve should be primarily related to the material you studied on the video. If you do **NOT practice, by solving problems**, you will probably learn very little from videos, or even from a live instructor, or personal tutor.

Below there is a subsection, with links to videos for studying mathematics. A few paragraphs below this, you will find a subsection with web links to obtain mathematics problems for practice.

How to Find Videos for Mathematics Instruction

There are many good search engines for finding videos with mathematics instruction. This includes <u>Google videos</u> (<u>www.google.com/videohp</u>), <u>YouTube</u> (<u>www.youtube.com</u>), <u>Khan Academy</u> (<u>www.khanacademy.org</u>), and <u>Mashpedia</u>

(<u>www.Mashpedia.com</u>). (Technically speaking, YouTube, and Khan Academy, are **not** really search engines.)

In the following paragraphs, I provide links for accessing over a dozen math-based subjects, with information on how to do your own video searches.

<u>Mathematics Videos from Mashpedia</u>

<u>**The best search engine to find videos for studying mathematics**</u>, or **for learning any subject**, is <u>**Mashpedia**</u> (<u>www.Mashpedia.com</u>). A simple technique that I use to find videos with Mashpedia is to place a / after the.com, followed by the subject I am searching for, such as the following examples:

<u>www.Mashpedia.com/calculus</u>,
<u>www.Mashpedia.com/matrix-algebra</u>

The following Mashpedia links provide **OVER** 100 videos, per link. (I have sometimes found over 800 relevant videos per link.) Each link opens a Mashpedia webpage, which usually contain approximately 50 videos per page. <u>To go from one webpage to another on Mashpedia, scroll down to the bottom of the page, and left click on the word **NEXT>>**</u>

Mashpedia Web Links (www.Mashpedia.com)

www.Mashpedia.com/advanced-mathematics

www.Mashpedia.com/algebra

www.Mashpedia.com/arithmetic

www.Mashpedia.com/basic-mathematics

www.Mashpedia.com/calculus

www.Mashpedia.com/differential-calculus

www.Mashpedia.com/geometry

www.Mashpedia.com/Hyperbolic-Functions

www.Mashpedia.com/integral-calculus

www.Mashpedia.com/linear-algebra

www.Mashpedia.com/matrix-algebra

www.Mashpedia.com/physics

www.Mashpedia.com/precalculus

www.Mashpedia.com/probability

www.Mashpedia.com/quadratic-equations

www.Mashpedia.com/set-theory

www.Mashpedia.com/solid-geometry

www.Mashpedia.com/statistics

www.Mashpedia.com/topology

www.Mashpedia.com/trigonometry

The Khan Academy (www.khanacademy.org)

Khan Academy, was specifically created as a learning resource, for a variety of subjects, including mathematics. The Khan Academy has its own online library, with a search engine for all types of courses, including mathematics. See the following
www.khanacademy.org/library. Khan Academy is a nonprofit organization, and all the services they offer are free.

Khan Academy has two major advantages over the search engines presented in this section. The most important is the material is organized into video courses focused on a specific subject, such as algebra, or calculus. The other advantage is each video course also includes some problems to evaluate what you need to learn, or for practice.

The Khan Academy has one major disadvantage over the video search engines, which is a limited number of courses. If you want to study an unusual or highly specialized branch of mathematics, you will probably not find it on the Khan Academy. Specialized fields of mathematics can usually be found easily with Google videos, Mashpedia, or YouTube.

Below there are a number of links to Khan Academy webpages, where you can access videos on the subjects indicated in the links.

Khan Academy Web Links (www.khanacademy.org)

www.khanacademy.org/math

www.khanacademy.org/math/algebra

www.khanacademy.org/math/arithmetic

www.khanacademy.org/math/calculus

www.khanacademy.org/math/differential-calculus

www.khanacademy.org/math/geometry

www.khanacademy.org/math/integral-calculus

www.khanacademy.org/math/linear-algebra

www.khanacademy.org/math/physics

www.khanacademy.org/math/precalculus

www.khanacademy.org/math/trigonometry

YouTube (www.youtube.com)

From YouTube: Algebra

From YouTube: Linear algebra

From YouTube: Trigonometry

From YouTube: Hyperbolic functions

From YouTube: Calculus

From YouTube: Differential calculus

From YouTube: Integral calculus

From YouTube: Geometry

From YouTube: Statistics

From YouTube: Probability

Mathematics Problems to Solve for Practice

It is important to obtain a good source of math problems to help you master the material you are studying. These problems should relate to the mathematics course that you are studying, and they should have answers that are easily accessible to check your calculations. Ideally, there should be a step-by-step explanation on how to solve each problem, along with the answers.

If you cannot find the ideal list of problems with answers online, it is best to purchase a mathematics book that has the specific type of math problems you are studying. In some cases, software-based tutorials can provide some or even all of the problems you need for practicing. Listed below there are a few resources that provide mathematics problems that are useful for practice.

SAT Math Problem Solving

GMAT Math Problem Solving

GRE Math Problem Solving

Sample Problems From Intermediate Algebra

Practice Solving Percent Problems

Practice with Solving Quadratic Equations

Solving Factorable Quadratic Equations

[Regents Practice Tests](#)

[Using Algebra Tiles to Help Solve Equations](#)

[AMC Problems and Solutions](#)

[THE CALCULUS PAGE PROBLEMS LIST Problems and Solutions
Developed by :D. A. Kouba](#)

[SOLVING EQUATIONS](#)

[Solving math word problems](#)

[THE CALCULUS PAGE PROBLEMS LIST Problems and Solutions
Developed by :D. A. Kouba](#)

[Paul's Online Math Notes](#)

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HYPERLINK TABLE OF CONTENTS

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