Creating a Format for Developing a Curriculum Tailored to the High School of the BRITISH VIRGIN ISLANDS

An Interactive Qualifying Project
Report submitted to the faculty of
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by

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1 Abstract

Since the islands fell under British rule, the British Virgin Islands High School has invoked strict education standards. Consequently, the curriculum prohibits creativity, does not properly accommodate learning handicaps, and does not provide students with a suitable technological background. Through interviews, investigations and pupil-teaching, this project has addressed all of these problems mentioned as well developed a textbook that will modernize teaching in the British Virgin Islands High School.

The investigation into the school's curriculum were made through test assessments, pupil interaction with technologies, including computer hardware and software, and calculators. Working with students in and out of the academic environment helped us to adapt to the customs of the island. All of these allowed us to properly assess the dynamics of the school, as well as the motivation of the teachers and students. Recommendations were made based on opinions as well these assessments.

2 Acknowledgements

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3 Authorship

Edith Ampadu, Bill Burgess, Jason Cobb, and Aaron Lopez contributed equally to the development, writing, editing, and construction of this project. The following work is entirely our own, we have not misused or misquoted any of our sources.

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4 Executive Summary

The British Virgin Islands have been an independent territory of the British since 1977. To this day, they follow Great Britain's standards, especially in terms of their education. Teachers are not given to design a curriculum for the students they teach; their main purpose is to prepare students for the Caribbean Examination Council (CXC) *Exam*. Students graduating from the British Virgin Islands High School have strong mathematics skills; however, they are unfamiliar with current math related technologies. It is critical to understand some of today's modern technology. If students plan to continue their education into university, technology will be very important. The British Virgin Islands are currently in a state of high economic growth. Consequently, corporate businesses and industries will create many jobs. One requirement for these jobs is a good education that includes a solid understanding of modern technology.

The goal of the project is to assist the teachers with developing a curriculum that is tailored to the specifications of the Caribbean Examination Council and the needs of the students. This sample chapter of the curriculum will consist of three books as well as notes on how to teach students with learning disabilities as well as the below average student. There is a student's manual, a teacher's manual, and a problem workbook.

The student's manual was designed to provide the students with explanations and notes for the topics within the curriculum that the fourth formers studied during the 1998-1999 academic year. The current textbook did not seem sufficient for the students to study from. Research has shown that a good textbook is one of the most important tools for developing good students. Therefore it is important to make sure that the textbook can address problems that the average student in the BVI encounters, such as test anxiety, how to take good notes, and proper study habits.

The teacher's manual is an advantage to the British Virgin Island High School. Along with an identical copy of the student's manual, this manual has background information on how to work with low performing students and students with learning handicaps. The book also gives advice on how to challenge gifted and excelling students. The manual has step-by-step instructions on assessing students' retention. The workbook is made up of 25 pages of problems that provide the students with plenty of exercises.

Teachers at BVI High School have been teaching for an average of 19 years. Many of the teachers feel that technology in the school is very worthwhile for the students. The teachers were questioned about what they considered to be difficult topics to teach to their students. They explained; the students supposedly have a difficult time learning different symbols, variables, and learning the basics of algebraic equations.

During our two-month stay, we learned how the BVI High School system works, through watching classroom activities, pupil teaching, and interviews. We were able to convince some administration that it was worth while to put time and effort into developing a program that encompassed technologies, specifically computers. We relayed many places to find scholarships and grants that can be used toward purchasing equipment, as well as seminars and workshops where teachers can go to improve their computer literacy and skills.

One issue we noticed during our time at the high school is that there are no programs for the learning disabled, no measures to help low performing students, and no ways to challenge gifted students. We found it necessary to address this issue because each of the different forms within the high school are divided into groups, in which the above average students are separated from the average and the below average students, and yet no special provisions are made for these students. During our time teaching the students, we also witnessed students who seemed to be very anxious about their tests. Our project has addressed this problem by including detailed instruction about assisting learning disabled and lower performing students, and students who may experience test anxiety.

Another issue concerns student behavior problems at the school. Some students have begun resorting to violence and illegal activities. Our recommendations have addressed this issue by suggesting an after-school program that will pair students with adult or teenage mentors. This mentor program will help keep problem students out of trouble, and offers an excellent opportunity to introduce these students to technology. For their system in which students are grouped into classes based on their abilities, we recommended that provisions be made for proper background training of the teachers who deal with the gifted, low performing, and learning handicapped students. We also recommended that the Government of the BVI implement a program that will improve computer and technology literacy with students and teachers.

5 Introduction

The British Virgin Islands consist of more than 60 islands, only 16 of which are inhabited. The islands lie at the northern end of the Leeward Islands, about 62 miles east of Puerto Rico, adjoining the United States Virgin Islands. The usual windy conditions complement the often hot, subtropical climate of the region. Shortly after the Spanish discovered these islands, they fell under British rule. To this day, they follow Great Britain's strict standards, especially in terms of their education, in which instructors teach classes with limited technology and little student interaction.

After a meeting with the principal of the high school, it was discovered that there is no program developed that works with students with learning handicaps, gifted students or students who perform below average. It is obvious that there are students who are well below average in the high school and are being "dragged along" in the school process. The principal says, “there is one student who is retarded, and we have one teacher that works with this student.” This is obviously a problem and something should be done. From first hand experience, it is seen that many students exhibit some symptoms similar to those students with ADD, test anxiety, and temporary lapse of memory.

Currently, the mathematics curriculum taught in the British Virgin Islands involves very little technology. The students learn primarily from lectures and long written exercises. Teachers are not given the freedom of designing a creative curriculum. Their main purpose is to prepare students for the Caribbean Examination Council (CXC) exam. Students graduating from the British Virgin Islands High School have strong mathematics skills; however, they are unfamiliar with current math related technologies.

It is critical to understand some of today’s modern technology. If students plan to continue their education into college, technology will be very important. The British Virgin Islands are currently in a state of high economic growth. Consequently, corporate businesses and industries will create many jobs. A requirement for these jobs is a good education that includes a solid understanding of modern technology.

The goal of this project is to design a format for developing a math textbook tailored to the needs of the BVI High School. This textbook will integrate technology and new approaches for helping low-performing students by taking into account different student learning styles. To develop this format we will work with teachers and students to find common problems encountered by BVI high school students in the math curriculum and the best ways to accommodate for them. We will also use information from a number of sources including teachers, students, the current textbooks, and recent research done on learning disabilities, test anxiety, and gifted students. We will develop sample chapters using our techniques that can be used as a model for future teachers to later carry on the process.

It is important to understand that one teaching method will not work for every student, yet a creative textbook and instructor can accommodate many more students than can traditional methods. Textbooks that accommodate all learning styles will result in a classroom that is not only more effective for the teachers, but which also provides a more interesting experience for the students. Students who find the topics interesting will often grasp material quicker and obtain a more worthwhile educational experience [12].

The students of Tortola will develop an understanding of why they are studying math when they are taught real life applications. An environment of mathematical exploration develops when students have an interest in their studies, and one way to develop an interest is to use context that is familiar to the students.

Our project will help the teachers to understand and feel more comfortable with teaching and using technology. Our final solution will have to take into consideration that every student must be prepared for the CXC examination. Providing access to technology has the potential to provide students a better understanding of the material, and give them the best chance at succeeding in today's high-technology world. The use of technology is controversial in the British Virgin Islands, so consideration must also be given to the amount and types of technology introduced. Another consideration is how to exercise students' knowledge. If the students of the British Virgin Islands receive a solid education, have knowledge of modern technology, and are good problem solvers, they will be ready to become the leaders of tomorrow.

2 Literature Review

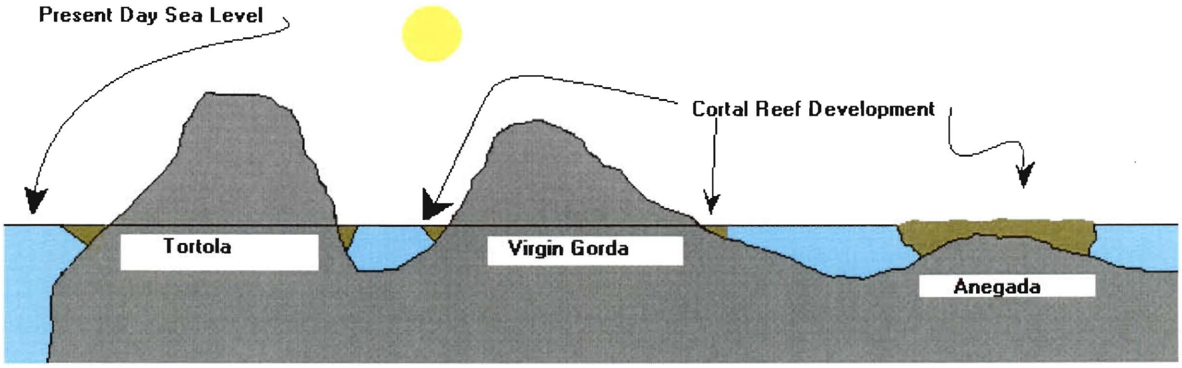
In this chapter, we will discuss important background information that is needed to have a better understanding of the culture and society of the British Virgin Islands. We will also discuss innovative teaching approaches used in education.

5.1 About the British Virgin Islands

The culture and society of the British Virgin Islands is not only important to the natives, but also important to the understanding of how their educational system works. This section will cover the history, economy, government, and educational system of the BVI High School in Tortola. In this chapter, you will also find references to proper techniques used by students to become stronger students, as well as some preliminary research compiled on students with disabilities and low-performing students.

5.1.1 History of the British Virgin Islands

During the formation of the Virgin Islands one hundred million years ago, oceanic volcanoes erupted, spitting lava throughout the sea. The lava was extremely fluid and spread over large areas of the seafloor. Other types of magma exploded violently above the sea thus forming piles of rock that eventually became mountains, explaining the reason for the unique type of rocks found on Virgin Gorda. Millions of years passed, and movements in the earth's crust caused the relatively new mountains to ascend upward forming volcanic mountains. The volcanic mountains were worn away by erosive action of the sea [31].



Except for Anegada, all of the British Virgin Islands are hilly. Around 30 million years ago, Tortola, Virgin Gorda, and Anegada were most likely one island. As the sea level rose, coral reefs began to develop on the perimeter of the island. Currently Anegada is beneath the sea with a layer of coral reef, explaining its unusual level terrain (see figure 2). Research explains that Anegada was well above sea level until about 20 or 30 thousand years ago, when glaciers began to melt, drowning Anegada [31].

In an interview with Ms. Marcey Potter, she explained that though there is little proof, it is taught that the Virgin Islanders are descendants of the Caribs. It is believed that the first person to land on the islands was an Amerindian from the Ciboney tribe of Venezuela. The tribe, Arawak, which resided on the island until 200 AD, when it resettled in the Antilles to escape its enemies the Carib Indians. Within the next century, Columbus reached the Caribbean [21, 31].

Around 300 BC, Ameridians from the Ciboney tribe of Venezuela reached the Virgin group, which was later overthrown by the Taino Arawaksat about 200 AD. Recent archaeological findings have confirmed that the Arawaks had settlements throughout most of the archipelago, later known as the British Virgin Islands. One century before the arrival of Europeans, the Caribs, another Amerindian tribe, invaded the area and enslaved the natives [9, 31].

In 1493, the Italian admiral Christopher Columbus came across Virgin Gorda and the neighboring islands, which he later called the "Virgin Islands." He named the islands this because the many islands reminded him of St. Ursula and her 11,000 virgins. The saint is currently on the flag of the Virgin Islands [21, 31].

Dutch voyagers were next to arrive at the Islands, formally colonizing them in 1620. Tortola became property of the Crown after British adventurers made several attacks on the Dutch and ultimately won. Because of the protected inland anchorage and advantageous lookout points, sea pirates quickly began to occupy the island. Eventually, legends arose about the buccaneering days of the 17th and 18th centuries, adding to the notoriety of the island [21, 31].

After Europeans settled the islands, they built plantations. Unfortunately, because of the terrain and lack of rain, the plantations were unsuccessful in growing much. African slaves worked the plantations, though many of the plantation owners were Quakers, who did not believe in slavery. As the Quakers began to immigrate to America, they set their slaves free or gave ownership of their plantation to the slaves. The Virgin Islands boast to have set free the first group of slaves [9, 21, 31].

Around 1834, an emancipation act freed the remaining slaves of Tortola, yet the new apprenticeship system made little improvements to the economic ruin. A subsequent cattle tax sparked a revolt in 1853; the recently freed slaves began to organize rebellions, and burn down plantation estates.

After the Antigua and St. Thomas military assisted Tortola, only four of Tortola's white minority families remained. The land was either taken over by former slaves or sold at low prices. The fields were left to deteriorate and the island entered a period of economic decline. Locals survived by farming and fishing, and managed to export some of their crops. The population dwindled from 10,000 to less than 5,000 within a century [31].

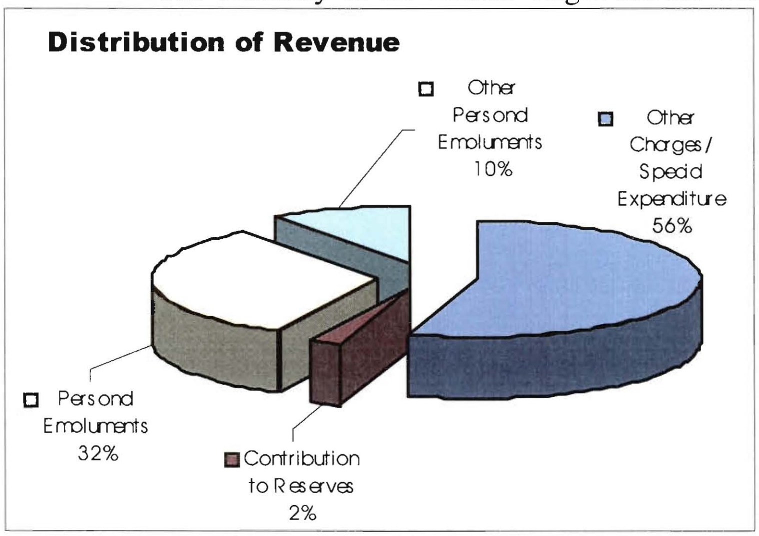
In an attempt to improve the standard of living, Britain began to implement a "compulsory education," overseen by a Governor-in-Council with a full-time representative on the island. Following the United States' purchase of St. Thomas, St. Croix, and St. John from Denmark in 1911, the British Virgin Islands began to recover from economic distress. As the newly purchased islands became a tourist attraction, so did the British Virgin Islands.

Elmore Stoutt, principal of the BVI High School, says that secondary education in the British Virgin Islands is comparatively new. He remarks that the current high school of the island began in 1943, while other Caribbean islands began their secondary education centuries ago. The campus buildings were begun in 1968. From the time of 1943 to 1968, the school buildings could only accommodate 150 students.

5.1.2 Economy of the British Virgin Islands

From the early 1980s through the late 1990s, the economy of the British Virgin Islands has been strong. The economy sees no signs of turning sour, for a number of reasons. The first main reason is that the government keeps a tight control of surplus funds, and makes sure that there is never a budget deficit. The second reason is that the government has a number of systems that allow quick changes to be made to avoid a downturn in the economy. The third reason is that tourism is an essential source of revenue for the Islands, one that is predicted to continue to prosper in the future. All of the current positive trends occurring with the economy are predicted to continue into the early 21st century.

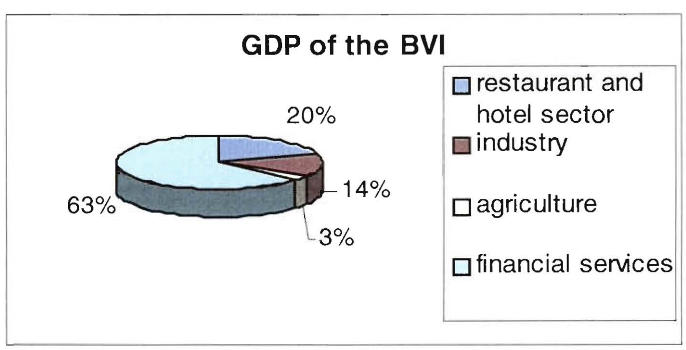
The economy of the British Virgin Islands was once fairly poor. Before 1977, the government was not focused on a balanced budget, and used "deficit spending" as a common procedure. The BVI depended on many types of assistance from the United Kingdom including budgetary and developmental aid. The BVI did not have its own budget and produced revenue only from customs and duties, income taxes, postage stamps, and other miscellaneous licensing and fees.



The BVI government played a large role in the turnaround of the economy. Since 1977, the government has focused on keeping a balanced budget. This effort has resulted in surplus funds that have been used for development of the Islands. For example, in 1996, the government ended up with a budgetary surplus of $13.2 million (US). The government has established a number of controls that can be used if the economy looks though it needs a boost. For example, many of the workers on Tortola are from other nearby islands. The government issues these workers a one-year working permit, which must be renewed annually. If a dip in the economy needs to be averted, the government will refuse to renew the permits, allowing more residents to find work. The government still receives a small allowance of aid from the U.K. This assistance amounts to approximately $10 million (US) and consists primarily of loans for developmental aid.

The BVI Department of Financial Services has played a large role in the strong economy. The focus of this department is to "establish the BVI as a high-quality international financial center, undertaking programs to expand its financial service offerings to meet the needs of international financial markets." [11] This department collects over $73 million (US), which is over 53% of the total money involved in the government every year. This funding is collected from fees from offshore companies that do business in the BVI. These fees are mainly from licensing fees for banks and companies, such as insurance companies, and from transaction fees from mutual funds.

The principal economic sector of the British Virgin Islands is made up of services, primarily tourist attractions and financial services. These two components accounted for 83% of the GDP (Gross Domestic Product) in 1995. These two areas are predicted to continue to grow at a rapid pace. An average of 350,000 tourists, most of who are from the United States, spend an average of 7.9 days each in the BVI every year. The tourism industry earned $136 million in 1995, and provided work for 33% of the working population, directly or indirectly. Nearly 30% of the GDP of the service industry was from the restaurant and hotel sector.



There are several other main contributors to the GDP of the Islands. Industry, which includes mining, manufacturing, construction, and public utilities, contributed 13.6% of the GDP and employed 16% of the workforce. Agriculture, which includes forestry and fishing, contributed 3.4% of the GDP in 1989.

The BVI exports several agricultural products, such as bananas and salt. Some manufactured products such as fiberglass boards are also exported. As for imports, most of the products used in the BVI are imported from the U.S. This has resulted in high inflation of prices of all products. The inflation rate is currently at 3.8%.

The British Virgin Islands became an associate member of the Caribbean Community and Common Market (CARICOM) in 1991. This organization allows the BVI to have close affiliations with the nearby United States Virgin Islands and to use American currency.

The future of the economy of the British Virgin Islands looks bright. The director of the Department of Financial Services states that the sector that needs the most improvement is in the private sector. He believes that there are not enough hotels for people to come to the Islands to do business. Other concerns are the monopolies in service, such as in the telecommunications area. Cable and Wireless, the only provider on the Island, is able to charge non-competitive rates and services.

A "Public Sector Investment Programme" was initiated in 1994 to implement improvements to the islands' infrastructure, with a focus in areas relating to tourism [10]. In mid-1997, the Caribbean Development Bank recommended the implementation of further public sector reforms to meet the needs caused by the increasing 'offshore' business sector and other financial institutions. In the early 2000s, the BVI will focus on training workers for higher-skilled positions, and gaining revenue through international arbitration. [30]

5.1.3 Government of the British Virgin Islands

The British Virgin Islands were formally part of the administration of Leeward Islands, having been annexed in 1672. The islands came under a separate administration in 1956 as a Crown colony. In 1967, a new constitution was written that provided for the ministerial system of government headed by a governor. The ministerial system was continued under the new Constitution of 1977.

The British Monarch, under the provisions of the 1977 Constitution, appoints the government of the British Virgin Islands. The government is responsible for the external affairs, defense and internal security of its people. The chairman has the official title of "Chairman of the Executive Council". The Executive Council has six members while the legislative council has 15 members, an ex-officio member, a speaker and 13 other members. There are different parties formed during elections and each of these parties elects representatives when that party is voted into office.

5.1.4 Education of British Virgin Islands

The high school system in the British Virgin Islands accommodates almost thirteen hundred students. The curriculum covers the last five years of a student's education before the student goes to college or joins the working class. The students are not placed in grades as in the United States, but instead use a form and level system, in which each form represents one year of school. The forms are divided into two series, called the 10 series and the 11 series. The 10 series is for the upper students planning on taking the Caribbean Examination Council (CXC) exam and going onto college. The 11 series is for the students who plan on graduating from high school and joining the work force. To allow for a better learning environment, each grade is divided into separate classes containing about 25 to 30 students.

The high school of the British Virgin Islands follows the standard British technique for teaching the sciences. It does not believe in assigning only one mathematics topic to the students based on their year in high school. Instead, each student learns many different math topics every year, which makes it easier for the students to grasp how they relate to each other. Since there is no topic of mathematics that is developed independently from another, the high school believes that the subject should be taught in a similar fashion.

In the first three years of high school education, the students are taught a general curriculum of topics in both the sciences and the arts. Toward the end of the students' third form, they are required to choose one of the following majors: accounting, literary arts, information technology, industrial technology, typing, automobile mechanics, electronics, woodworking, home economics, or arts and crafts. During their final two years, they focus their learning along one of these paths. Upon graduation, depending on the path chosen, they will be qualified to get a job without any further training.

5.2 Reasons for Technology

Technology will be an important part of our project; therefore, it is necessary to define technology and discover its role and effects in education. Before one can justify the use of technology in education, there must be a clear understanding of the meaning of technology. The word technology is difficult to define; it is usually attributed to the use of innovative equipment, but there is a broader meaning. Technology is the systematic process joining people and technological tools for the goal of continuous improvement [13]. This implies that technology is more than just using new innovative tools; technology is anything that advances the current state of knowledge. There is no debate that technology is becoming an increasingly large part of the education of the world's youth. The question is whether technology has a positive impact on education. The use of technology as a learning tool has an effect on student achievement, attitude, and interaction with educators and fellow students. Technology is and always will be a part of everyone's life. Therefore, it is critical to discover technology's place in education.

5.2.1 Achievement

Educational technology has been found to have a significant effect on student achievement in nearly all subject areas, from pre-school through higher post-secondary education. Research has shown that the effectiveness of educational technology is determined by the characteristics of the students, the goals of instruction, and how the educator chooses to implement the technology [7]. These three features must be strongly considered by each educator when designing a course plan. The educator must take into account the audience being taught and what information the students should gain.

Research has demonstrated that the use of technology as a learning tool throughout primary and secondary education has many benefits [3, 34]. It has been shown through comparison studies that students who were given access to technology had a better understanding of material than students who had been studying the same material for a longer period [21, 33]. These students also had a higher level of retention than the traditionally taught students did.

5.2.2 Attitude

Educational technology has been found to have positive effects on students' attitudes towards learning and on their level of self-confidence. Students who have an interest in what they are doing generally tend to put more effort into their work [7]. Evidence suggests that in the areas of language arts, mathematics, and science, students were more motivated to learn and had a higher level of self-esteem when using technology based instruction [17]. This is because students who master a topic when using technology have a feeling that they have some control over their learning environment [17]. They also have less anxiety towards mathematics, are more likely to see the need for mathematics in the real world, and will be more willing to take on more challenging problems [55]. Students who are highly motivated naturally form an environment of cooperative learning. An environment such as this benefits all students; the less knowledgeable students benefit from the knowledge of the stronger students, and the more competent students gain an even better understanding by explaining the concepts in their own words to their fellow students [7]. It has been shown that students taught with various technologies have a lower number of absences and a much lower rate of high school dropout than those who aren't taught using technologies [7].

5.2.3 Interaction with Educator and Other Students

A common fear among many educators and parents is that if students are taught with technology, the personal relationship that has always been formed between student and teacher will be lost. Throughout the United States, teachers are starting to design their lesson plans around the student, making the curriculum more stimulating. Teachers have found it necessary to design lesson plans that allow for more teacher-student and student-student interaction [7]. Recent research has proved that the use of technology creates an environment of high student interaction and collaboration [40].

Technology has also been shown through many studies to make teachers better educators. This is due to the fact that teachers who use technology are more willing to spend time on a topic they have little expertise in [4]. Technology also allows teachers to assign large projects that help students simultaneously learn multiple topics within and between subject areas [4].

5.3 Innovative Teaching Approaches in Education

This section covers the importance of some of the technologies we may use as well as an explanation of contextual teaching.

5.3.1 Calculators

Calculators are mechanical, electromechanical, or electronic devices that perform arithmetic operations automatically. Few inventions of recent times have had such a profound influence on the daily life of industrialized nations as the hand-held, or pocket, electronic calculator. Early calculators were mechanical; they performed their computations using machine parts, such as disks, drums, and gears. These calculators were first powered by hand, then later by electricity. By the mid-1950s many of these mechanical calculators were being replaced by electronic calculators, which contained integrated circuits, in some cases like the circuits found in computers, to perform mathematical functions. In fact, the sophisticated electronic calculators of today are actually dedicated, or special-purpose, computers.

The development of miniature solid-state electronic devices brought a series of electronic calculators that were capable of far more functions and much faster operation than did their mechanical predecessors. The original electronic calculators were capable of little more than the basic four arithmetic operations. As technology has progressed, many developments have taken place. Developments have led to scientific calculators, and in the late 1980s, graphing calculators. The introduction of the graphing calculator has had a profound effect on the educational and scientific communities. The use of the graphing calculator has evolved from primarily in algebra to current roles in advanced calculus and new programs that allow many advanced tasks to be performed for chemical and electrical engineering problems [41].

5.3.1.1 Effects of Calculators on Education

Even though research has suggested calculators to be beneficial tools in the classroom, there are still many myths regarding their use that has limited their acceptance. These myths have served to hinder the integration of technology into education, and simply defeat one of the primary purposes of education [41].

Times greatly changed from the late 1970s until the late 1990s. A person could once graduate with only a mediocre understanding of algebra and geometry and still be successful. Now math is becoming increasingly prominent in areas other than the traditional engineering and science fields. Students need to have a solid understanding of more advanced math topics. The ability to solve problems is also becoming an increasingly more important and valuable asset. Research has shown that students who are above average in their math skills are good problem solvers [16].

There is no argument that the use of calculators in mathematics makes the work easier. That is the goal of calculator advocates. Using calculators makes work easier by taking away the multiple elementary steps. This allows students to spend their time concentrating on the new concepts being taught and how to apply them to practical applications and word problems. This gives them a chance to truly learn the theory behind the math by doing many more examples than could be done with the original pencil and paper method.

Many believe that students will become entirely dependent on the technology that is supposed to be aiding them in their learning process. This is the challenge for the educator. Any student can plug numbers into a calculator, but it will take a student with knowledge of the mathematics to know if the answer makes sense. Calculators are only as accurate as the information entered into them. Research has shown that the use of calculators in cooperation with mental math and estimation skills improves students' problem solving capabilities. The role of calculators is not to replace conventional methods, but to be combined with them in order to improve the quality of education [7]. Calculators, with all their speed and capabilities, can never replace the ingenuity of the human mind.

Many argue that the desire of students to use calculators is based on laziness. Nevertheless, there is no creative thinking in doing basic mathematical calculations repeatedly. Doing calculations of this type only serves to make math tedious, making students afraid or unwilling to take the time to learn the true mathematical concepts. Calculators are tools that allow students to learn math and solve problems in a way that stimulates interest rather than discouraging it [55]. Educators claim calculators make it possible for students to develop an appreciation for the importance of math in the real world [55].

In the real world, after students graduate from high school, calculators are indispensable. They are used in every field from the highest-technology engineering firm to the local convenience store. There is no argument that students go to school to prepare for life in the real world. Part of the real world, of course, involves the use of calculators.

5.3.1.2 Advantages of Calculators

Many adults have developed fears of math while in school simply because they rarely came up with the correct answer. Many times this was not due to an unacceptable understanding of the material, but due to so called "careless mistakes" that occur when students rush to do many simple calculations in a short period of time. It is discouraging when students go into an exam confident in their abilities, but receive a poor score due to accidental mistakes [7]. This makes the students feel as though success cannot be achieved in math. Calculators have the ability to remedy this problem. They take away the long tedious work, and leave the students much more time for solving the real problem. They do this without taking away from the thought process needed to solve the problem.

There is a lack of women in many of the science and engineering fields. Studies have shown that this is because most women are behind men in terms of their math skills. However, recent studies on the effects of calculators has shown that their introduction into schools' curricula has taken a big step in closing the gender gap by increasing women's math and science scores [7].

Calculators have a natural ability to generate interest in mathematics [55]. Calculators are enthralling from the time a child first uses a calculator to do tedious arithmetic quickly, to the time when a junior high school student sees the graph of a function. Calculators do almost instantly what we humans spend a great deal of time doing. They allow for mathematical exploration to take place. For example, students playing with calculator functions quickly see patterns develop and ask questions about unfamiliar topics. This kind of interest is beneficial to the learning environment.

By putting students in an atmosphere of cooperative learning, even students who are not gifted can still excel [3, 22]. Cooperative learning students are able to work together to figure out their own ways of solving problems. Many times students cannot communicate with teachers the same way they do with their classmates. Calculators support this cooperative education much more than the traditional pencil and paper method does. This is true because there is less time wasted doing a series of trivial calculations that everyone finishes at a different time. Instead, the students spend most of their time thinking out strategies to solve problems.

5.3.1.3 Graphing Calculators

Graphing calculators have many benefits but also the possibility of adverse effects. Graphing calculators have the ability to do almost any math from algebra to advanced calculus. These calculators can be immensely beneficial in the learning process, but there is also the risk of student misuse [22]. The teacher plays an important role here. Teachers should closely monitor which calculators are used, and exactly how they are used. Teachers will have to take the time to establish exams that test the students' true knowledge, not their calculator skills. This can easily be done with real life applications and word problems.

Graphing calculators allow students to learn by visualization. With these calculators, students are able to learn for themselves the relationships between functions and their graphs.

Being able to see the graphs of functions on a calculator makes the math more concrete to the student. The mathematical concepts become much less abstract. The ability to draw graphs accurately was formerly learned in students' first course in calculus but now, with calculators, students are able to learn the concepts much earlier. Students are able to try many different operations and functions and see a list of results on the screen. Many of these calculators allow students to learn the actual math concepts because they are able to do symbolic calculations. These calculators are capable of being programmed with equations in order to perform complex tasks which saves valuable time especially when the tasks need to be done multiple times. Once the student truly learns an advanced topic, the calculator can be used to do the math so that the concept can be learned and the process of full mastery begins. Graphing calculators for the first time allow students to demonstrate their true mastery of the topics with full confidence and with little error. These calculators are capable of a multitude of tasks, some of which are almost at the level of a computer.

5.3.2 Computers

The system by which a society provides its members with those things necessary to be successful has changed over the years. Machines and computers shape today's society. It is hard to imagine the world today without computers; computers have many uses including word-processing, multimedia, the Internet, and spreadsheet applications.

In the 1960s and 1970s, when computers were first introduced to schools, they were set aside in separate labs. Teachers used them largely to teach stand-alone courses on computer programming. Around 1977, educators began to view computers as an efficient way of providing supplemental material and exercises. These exercises might use colorful graphics and cartoon figures to quiz students on classroom material. A student with a word processor can use spelling and grammar checkers to make sure reports and presentations are error-free. Students can also print out multiple copies of their reports without having to retype the report multiple times.

Electronic mail (e-mail) has improved and simplified communication between teachers and students. It makes it easier for students and teachers to communicate outside of the classroom. Through e-mail, new ideas do not have to go through a chain of command in the educational system. The information is received by everyone at the same time and can be acted on quickly. Research done by cognitive scientists suggests that computers are essential to the success of a person's education. Jensen, a cognitive researcher at the University of Minnesota, concluded, "students in classes with computer-based programs demonstrate a greater understanding of materials than students who did not have access to the computer programs" [25]. Inspired by the research of cognitive scientists, educators began favoring classroom environments in which students take charge of their own learning, learn to think critically and analytically, work collaboratively, and create products to demonstrate what they have learned. By putting learning in the hands of students, the application based teaching model completely reverses the old style of schooling in which a teacher stands in front of a room and lectures [14].

Some views held by teachers, however, make it difficult for computers to be integrated into the educational field. Some believe that work done by people is much better than work done by computers. Other educators believe that learning by computer is not really learning at all. They think that without notebooks and textbooks, students cannot do any efficient studying. "A teacher might use technology poorly, use it well, not use it at all, may not be motivated, or may lack the knowledge required to apply the technology," says Ted Hasselbring, a co-director of Vanderbilt University's Learning and Technology Center in Nashville, Tennessee. Thus, the real question for educational technology is not "Does it work?" Rather, it's "When does it work and under what circumstances?" [14]

Though there is no guarantee that computers improve students' achievements, integrating technology into an educational curriculum helps students to learn more quickly and efficiently while keeping them interested in what they are learning [7]. Research on the effectiveness of educational technology offers mixed results. Some applications have been unquestionable successes; others have yet to prove their contribution. New research on technology's effectiveness in teaching mathematics appears to confirm what many educators have suspected: "Computers can raise student achievement and can even improve a schools climate." That was said by Harold Wenglinsky, an associate research scientist at the Princeton, New Jersey based Educational Testing Service, who carried out the analyses for *Education Week Magazine*. When asked if technology can improve education, experts such as Hasselbring say, "It depends…its kind of like asking, 'Are pencils effective?' It depends on what you're going to do with them."

It has become increasingly evident that computers and other kinds of classroom technology can help bring about a transformation in an educational curriculum. There are many anecdotes about schools that have successfully used technology to reshape teaching and learning and to raise student achievement; however, the definitive, large-scale studies that make the case for these newer, more integrated uses of technology are harder to find and have less clear-cut conclusions.

"Computer tutorials are about as effective as personal tutoring," says James Kulik, an expert in developmental education and a research scientist at the Center for Research on Learning and Teaching at the University of Michigan. He and his colleagues reviewed more than 100 studies, which compared a classroom using computer-aided instruction for four weeks with a classroom that did not. He concluded that students in the classrooms where computers were used learned more and learned faster. They gained the equivalent of about three months of regular classroom teaching and learning. [27]

Students in Union City, New Jersey, for example, made significant learning gains after the district underwent an extensive technological conversion. But it is hard to tell how much of the success was the result of the equipment and how much could be attributed to other educational innovations taking place in the district's schools at the same time.

"At this point, there are more claims about what technology can do than there are well-designed evaluations with conclusive findings," concludes a draft report conducted for the U.S. Department of Education by the Washington-based American Institutes for Research. Part of the problem is that the trend toward application based teaching and learning is relatively new, and technology has been used to support it only in the past few years [14].

5.3.3 Teaching Through Context

There are a number of considerations teachers should be aware of when teaching students new material. Teachers need to be attentive to learning styles, as students retain information in different ways. Teachers should also pay attention to the effectiveness of the methods used in the classroom, reuse methods that work well, and discontinue methods that do not work. Most importantly, teachers should make sure that all new material is taught contextually.

Contextual teaching is a method of teaching with respect to the circumstances that affect the material and is familiar with the students surroundings.. Context gives meaning, relevance, and usefulness to learning. There is evidence that when students learn material that is delivered through the context of their lives, learning becomes more meaningful and enjoyable. Students prefer learning information that they believe will be used in their daily lives, over information they believe has no connection to their lives. Students who learn material that has significance in their lives are more likely to retain the material than students who learn material with little significance to them.

John Dewey (1859-1952), who advocated a curriculum and teaching methodology tied to students' experiences and interests, first proposed the application of contextual learning to the classroom. Dewey had several goals in mind, but essentially, he wanted to create a classroom where students become active participants rather than passive observers, a place where students are responsible for their own learning. It was his belief that students work more diligently when they are learning content that is interesting and meaningful. Another benefit of this style is that more enjoyable teaching will take place.

Contextual learning research has taken place for decades. In late 1925, Wolfgang Köhler, a psychologist trained at the University of Berlin, researched the mentality of primates using a variety of experiments involving obtaining food that was not directly accessible. During these experiments, an ape was confined to a cage, and given two sticks. Nearby was a banana tree. The ape began to realize that neither stick could reach any of the bananas, yet when it put the two together, it was able to bring a banana into the cage [28].

From Köhler's experiment, it seems there is a fundamental relationship between application and learning. A student learns math similar to an ape learning to put two sticks together, yet what is learned is useless to both the student and the ape if they do not know how to apply their knowledge. An ape can apply the knowledge of putting two sticks together to get a banana, as a student can apply the knowledge of mathematics to other subjects. In another finding by Köhler, the ape was not able to get a banana from the tree until it realized that the banana could be brought into the cage. Similarly, a student will be able to apply what has been learned once the application has been introduced [28].

Contextual learning, if used improperly, can have negative effects. The improper use of contextual learning in a number of situations has created a number of opponents to the idea. Marianne Jennings, a professor of ethical studies at Arizona State University, believes that contextual learning is not being used correctly by the National Council of Teachers of Mathematics. The Council sets the standards for the mathematics curriculum and in 1989, in response to the consistently poor math scores of U.S. students, issued new standards to reform math education. Jennings commented specifically about Addison-Wesley's "Focus on Algebra", developed in response to standards developed by the Council to provide students a more conceptual understanding of math. She believes that the text was *too* focused on conceptual understanding of mathematics, and not problems and practice. She commented that she thought the text was more like a social-science text with a lot of color photos, essays, cultural study information, and information about the environment. Jennings believes that the idea of contextual learning might work; however, the focus should be on problem solving and practice [25].

However, in opposition to Jennings, there is evidence that contextual learning works. In many of the states that have emphasized this approach, there are indicators of increased student performance. For example, in Connecticut, the combined mathematics SAT scores have risen 15 points. These improvements in student performance have often been attributed to contextual learning techniques. Some proponents, such as Kathy Pullman, a teacher at the Fernangeles Elementary School in Sun Valley, California, say, "this approach makes students better problem solvers. They will think more." Other advocates argue that people need to be patient because contextual learning in mathematics is a new approach. Thomas Romberg, a University of Wisconsin professor who helped to write the current (1989) standards for the National Council of Teachers of Mathematics, says, "We knew it would take 20 or 25 years to pull this off" [33].

While contextual teaching is still in its formative stages, research has already shown it to be a positive teaching tool in many ways. Many schools have seen improved student performance by using such techniques. It seems that the schools that most effectively use contextual teaching teach all essential material that needs to be covered in a class without spending too much time on the proper context. There have been professionals who oppose the implementation of contextual teaching, but there is also evidence to prove that this style can improve a student's understanding of mathematics. It is at the discretion of the instructor to assess the students to determine if this style will help.

5.4 How to be a Good Student

There are a number of techniques used by students all over the world to improve grades. These techniques include proper study and note taking habits. Scheduling and organization are two of the most important skills a student can learn. In the following sections, we investigate these techniques, hoping to find an effective way to relay them.

5.4.1 Effective ways to Study

Studying has always had an impact on an individual's academic achievement. There are different ways to study and for different people, these differences have different effects. Trying different things is the only way to determine which way works best. Some people like to study in complete quiet, while others prefer to study with music, or in some extreme cases, with a movie on. To study properly, students should be taught the following advice.

Time scheduling does not make a perfectly efficient student. Very few students can rigorously keep a detailed schedule day after day over a long period. In fact, many students who draw up a study schedule and find themselves unable to stick to it become impatient and often give up the scheduling idea completely.

The following method of organizing time developed by a university in Vermont has been helpful to many students and does not take much time. It is more flexible than many methods and helps the student to establish long term, intermediate, and short term time goals. [15]

Long Term Schedule

Students should construct a schedule of only fixed commitments. These include only obligations they are required to meet every week, e.g., job hours, classes, church, organization meetings, etc.

Intermediate Schedule - One per week

Now the student makes a short list of major events and the amount of work to be accomplished in each subject for the week. This may include non-study activities and recreation. For example:

- Quiz Wednesday
- Paper Tuesday
- Ball Game Tuesday Night
- Finish Research in Forensics by Friday
- Finish 150 Pages in Biochemistry by Friday

These events change from week to week, so it is important that the student makes a new list for each week. Sunday nights may be the most convenient time to do this.

Short Term Schedule - One per day

On a small note-card each evening before retiring or early in the morning, the student should make out a schedule for the next day, making it easier to remember the things that need to be accomplished for that day. Such a schedule might include:

- 8:00 AM - 8:30 AM Review History
- 9:30 AM - 10:30 AM Review Math and prepare for Quiz
- 7:00 PM - 10:15 PM Read Chapters 5 and 6 of Biology textbook
- 10:30 PM Call Granny in Ghana

It is necessary that students carry the card with them and cross out each item as it is accomplished. Writing down things in this manner not only forces students to plan their time but also in effect, causes them to make a promise to themselves to do what has been written down.

Distractions: External distractions are those that originate outside the body. Telephone calls, visitors, and noises are examples. Concentration may be difficult when there are too many such distractions present. In the presence of such external distractions, the ability to concentrate on studying is difficult. To avoid this, the student should find a place to study where there are no external distractions.

Acronyms: The use of acronyms can be helpful when a list of facts or sequence of items must be remembered. An acronym is a word or phrase made from the initial letter or letters of each of the successive parts or major parts of a compound term. For example, the acronym IUPAC stands International Union of Pure and Applied Chemistry. Acronyms can be created by students to remember a specific item, such as the planets in our solar system in sequence (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto). Taking the first letter of each word, would yield m, v e, m, j, s, u, n, and p. Students could be suggested to make up a nonsensical phrase to help them remember the exact order, such as, "My very eyes may just see under nine planets."

There are several advantages to learning, these include the following:

1) Better understanding of concepts. Students who study usually understand concepts easier and tend to do better on examinations.
2) Increase in confidence.

3) Improvement in test scores [15].

5.4.2 Note taking

Proper note taking is very important to students achieving success with their studies. Taking and using notes correctly allows students to retain more class material, enjoy their classes more, and possibly even help students improve their grades. Being able to take notes in the correct manner is a very valuable skill.

The student's notes should provide a summary of the material covered by the teacher during class time. Since most teachers only cover important topics during class time, the student's notes should be key to learning the essential material for the class.

The notes should be used to help the student remember the ideas and facts presented. Reorganizing and/or editing notes throughout a course will allow the student to be fully versed in all of the class material and could help avoid re-learning a lot of information before an examination. Notes may also help the student overcome nervousness and fear of examinations because of this extra learning and preparation that takes place.

Before class, the student should first review, edit, and organize the previous day's notes. Secondly, the student should consider what may be presented in today's class. Then the student should study today's lesson, text, or readings. Finally, the student should preview the lesson for the next day. Using these steps will allow the student to recap the information from the previous day's notes, start considering what will be covered in the current day's class, and be fully prepared for the following day's class.

During class, the students should sit at the front if they normally have difficulty concentrating. The students should do more listening and thinking and less writing if the material being covered is well understood. The students should also watch for verbal or visual clues that indicate main points and make a note of these. Questions should be asked or written down for further clarification as necessary. The students should maintain eye contact with the teacher whenever possible. The students should also have a clear system of notes that is used every day.

After class, the students should edit and organize the notes as soon as possible. The sooner they are edited and organized, the less that will be forgotten. The students should then reorganize the notes taken. This might include numbering, labeling, or underlining to stress major and minor points, removing repetitions, adding or clarifying as appropriate, labeling the margins with key topics, and reducing the total amount of notes.

The students should then turn their notes into material review documents. This can be done by writing summary statements, turning major headings into questions to use in selective reviewing, marking points expected to be included on the test, and by writing possible questions on the material given. These steps will lead to improved note taking and studying. [23]

5.5 Teaching the Disabled and Low-performing Students

Low-performing students should not be overlooked. Often the problem is finding an appropriate outlet for these students to express themselves, though it is possible for the problem to be a mental handicap. Instructors should receive proper training dealing with these types of disabilities. The following information describes just the surface of a multitude of information available on various types of disabilities. It is up to the instructor and school administration to develop some kind of program that will educate teachers further.

5.5.1 Learning Disabilities

Learning disabilities seem to be difficult to define; there is not one acceptable definition. Several definitions have been proposed; putting different definitions together, for example, one can say a person has a learning disability when the person's ability to learn does not meet their capacity for learning. This is true only when the ability to learn is not equal, not when there are outside confounding factors that interfere with the person's learning. Learning disabilities are a result of a mental or physiological disorder. There are several types of learning disabilities each having different symptoms and complications.

Some children develop and mature at a slower rate than others in the same age group. As a result, they may not be able to perform the expected schoolwork. This kind of learning disability is called "maturational lag" [54].

5.5.1.1 Causes of Learning Disabilities

In some cases, children with normal vision and hearing may misinterpret everyday sights and sounds because of some unexplained disorder of the nervous system. Injuries and medical problems before birth or in early childhood and premature birth have been found to cause some learning disabilities. Learning disabilities are more common with boys than girls, possibly because boys tend to mature more slowly. Learning disabilities tend to run in families, so some learning disabilities may be inherited.

Some learning disabilities appear to be linked to the irregular spelling, pronunciation, and structure of the English language. This is because research has shown that the incidence of learning disabilities is lower in Spanish and Italian speaking countries.

5.5.1.2 Symptoms of Learning Disabilities

It is very easy to recognize a person with a learning disability. Some of the symptoms that are usually evident in children of school going age are:

- Poor performance on group tests
- Difficulty discriminating size, shape, color
- Difficulty with temporal (time) concepts
- Distorted concept of body image
- Reversals in writing and reading
- General awkwardness
- Hyperactivity
- Failure to see consequences for own actions
- Excessive variation in mood and responsiveness
- Overly distractible; difficulty concentrating
- Little understanding of the concept of left and right
- Short attention span
- Difficulty doing concrete mathematics
- Poor organizational skills
- Easily confused by instructions
- Difficulty with abstract reasoning and/or problem solving
- Disorganized thinking
- Often obsesses on one topic or idea
- Low tolerance for frustration
- Poor peer relationships
- Difficulty copying accurately from a model
- Slowness in completing work
- Overly excitable during group play
- Behavior often inappropriate for situation

It is necessary to know these symptoms because it is important to identify students who may have learning disabilities. For example, in an experiment, it was found that a number of students with learning disabilities made mistakes in arithmetic because they lacked a secure sense of left and right. If required to do long division, they would have difficulty knowing whether to work from left to right or right to left. By knowing this, the teacher can work on improving the students' sense of left and right. A teacher should not discourage students by focusing on topics that they have difficulty understanding [18].

5.5.1.3 Effect of Learning Disabilities on other Students

In schools in which students are grouped into classes based on their abilities, the probability that the students with learning disabilities are grouped with students who are performing below average not due to a disability is very high. For the students who are below average and do not have a learning disability, the effect is very great. There is often a lack of competition in these classes so the students do not have the chance to improve upon their capabilities. They seem satisfied with their grades and do not strive to do better, because they think they are doing excellent work compared to their peers who are not doing as well because they are disabled.

5.5.1.4 Dealing with the Learning Disabled

In order to address the needs of the learning disabled student properly, the following ten principles have been suggested by experts [18, 54].

1. There is no single correct method to use with a learning disabled child. Learning disabled individuals have different ways of adapting to new things. These ways are not the same even with a particular person. New ways must be used to provide variety in all activities.

2. All factors being equal, the newest method should be used. Children with learning disabilities often tend to lose interest quickly. It has been proven that these students are often quick to adapt to new methods of instruction and tend to learn from them better. It is therefore important to continuously change the approach to teaching.

3. Some type of positive reconditioning should be implemented. Learning disabled children should not be allowed to feel as though it is their fault that they cannot reach the same levels as their peers. It is extremely necessary to boost self-esteem and build confidence.

4. High motivation is a prerequisite to success deliberate consideration of the affective domain is essential. It is important that the teacher keeps the students interested in their education. In order for the student to learn they must have a high level of interest in the topic. Many times this is done by keeping the curriculum new and refreshing.

5. The existence of non-specific or difficult to define disabilities must be recognized, particularly in older children. It is not always easy to define or diagnose a disability in children. Each child's disability is different and has occurred for different reasons. Many times it may appear that there is a learning disability but in reality the child had a learning disability during the early life stages and grew out of it. What remains is just the lag due to the early disability. Sometimes children grow up with physiological disabilities such as a visual impairment and never develop a full visual or auditory library and suffer due to the misinterpretation of sights and sounds.

6. Complete, accurate information about learning strengths and weaknesses is essential. Planning classes for the student with a learning disability should be based on their current knowledge. Different tools should be used in determining the strengths and weakness to ensure that the information obtained is up to date.

7. Symptoms often associated with learning disabilities do not necessarily indicate the presence of learning disabilities or predict future learning disabilities.

8. Education time and effort must be carefully maximized for the child with learning disabilities.

9. Learning disabilities planning should be based on a learning theory (or theories) to be most effective.

10. It is critically important to be concerned and involved with both process and task-oriented assistance and remediation.

5.5.2 Teaching Low-Performing Students

Teaching the below average student has a lot in common with teaching the learning disabled student, but there are important differences. These differences have to be noticed or the quality of the education given will have unfavorable effects on both the below average student and the learning disabled student. Therefore, it is extremely important for teachers to know which students have learning disabilities and which are just below average and need more attention. Once diagnosed, these students usually need to be separated at least in part. Much of their education will have common points but there are also parts in which each group must have their personal needs met.

To teach the below average student a lot of time must be spent planning classes. The teacher must be well prepared and have sound reasoning for everything done. In planning the curriculum, experts have suggested that the teacher take into account four principles:

1. Education is a process, which continues throughout life.

2. There should be open access to a wide range of educational choices and opportunities.

3. There should be provision for building individual competence and skills.

4. The educational process should promote self-confidence and self-awareness.

If a curriculum is to be changed to address the needs of below average student, attempts toward change must also recognize:

a) It is necessary and desirable to obtain relevant usable information about the learning difficulties of all pupils with special educational needs and to arrange for individualized learning programs for those pupils.

b) It is not, however sufficient to treat the pupil on an individual basis. Pupils are members of a multicultural society and subject to the same opportunities and stresses as everyone else. This has clear implications for the selection of curriculum content and for methods.

c) The pupil has to learn with in the organization of the school with all the values of its hidden curriculum. These are sometimes more important in determining whether learning occurs than the overt arrangements and must, therefore be considered.

Making these considerations aids a teacher in designing a curriculum that best improves the student's ability.

5.5.3 Test Anxiety

An anxiety disorder is defined as "some group of mental illnesses involving low combination of excessive worry or fear, motor tension, physiological symptoms and arousal and increased awareness of one's surroundings" [2]. There are a variety of anxiety disorders, including panic disorder (agoraphobia), generalized anxiety disorder, social phobia, simple phobia, obsessive-compulsive disorder, and post-traumatic stress disorder.

Some common symptoms include relentless trembling, muscle tightness, heart pounding, difficulty falling asleep, dizziness, irritability and decreased ability to concentrate. It is important to realize that before making a proper diagnosis, many of these symptoms must occur together and over a period of several weeks, either continually or periodically. Often, most anxiety disorders appear in late adolescent or early adulthood, though no age is guaranteed immunity [2].

Test anxiety is specific type of anxiety disorder and is defined as an "unpleasant emotional state characterized by subjective feelings of tension, apprehension and worry and by activation or arousal of the autonomic nervous systems." [52] It is a learned response, often characterized by uneasiness or apprehension before taking a test. Up to a certain point, it can improve a student's performance. However, extreme persistent tension can cause fear, dread, nervousness, and loss of sleep or appetite [3]

Test anxiety occurs when students are so nervous about preparing for or taking a test that they encounter difficulty with planning, thinking, concentrating, recalling what they studied, and relaxing [2, 3, 52]. Traditionally, the test-anxious student is characterized as dependent, inefficient, excitable, and insecure, while the student's parents are characterized as demanding, non-affectionate, and often hostile. [52] This anxiety is an issue that many students face at one time or another, and is important to be able to recognize test anxiety and learn how to deal with it more effectively.

In a survey of 1500 students, over 76% admitted to experiencing test anxiety, which affected their results on standardized tests [19]. Seventeen percent of high-anxious students drop out of post-secondary education, compared with only 5% for low-anxious students. Twenty-nine percent of highly test-anxious students have a GPA below 2.00-2.51 mean compared to only 7% of low test-anxious students with a GPA mean equal to 2.86 [52]

Some common symptoms of test anxiety include:

- Headaches
- Nausea
- Feelings of despair
- Shaking and trembling
- Blanking out
- Butterflies in the stomach
- Sweating
- Shortness of Breath
- Quickened pulse rate
- Worry
- Fear

[2, 52, 3, 1, 50]

There are different kinds of testing anxiety. These include the following:

Cognitive Anxiety: This anxiety is characterized by a lack of focus during the exam due to unnecessary thoughts running through a student's mind before, during, and after the dreaded event.

Emotional Anxiety: This anxiety includes the feelings that students experience related to a specific event. These feelings are feelings of embarrassment, disappointment, happiness, or anger.

Behavioral Anxiety: Unusual body movements due to stress characterize this anxiety. These unusual body movements include walking quickly, fidgeting, and drumming your fingers.

Physiological Anxiety: This occurs when the body responds to stress and anxiety through increased sweating, dry mouth, diarrhea, increased urination, increased heart rate, and feeling of heart attack.

There are a number of ways to reduce test anxiety. Proper study habits and recreational activities are key to cutting anxiety, though, undoubtedly, focusing on relaxation prior to, and during the test are the most important [21].

The student should be prepared for the examination. A study plan should be made and followed strictly. All materials should be thoroughly learned, and to the extent possible, the student should study under conducive settings with no distractions. Experts say recreation, study breaks, exercises, and a good night's sleep before the examination, reduce tensions and stimulate thinking. Students who perform a last minute review before the examination have less confidence approaching the examination, and fail to realize that the examination is just an opportunity to show how much they have studied and to receive a reward for the studying they've done. Most important of all, the student needs to take some deep breaths and relax before the examination.

When examination time comes, the students should read the instructions carefully and then learn the marking scheme of the test and plan to divide their time evenly among the available marks of the exam; e.g., spend ten percent of your time on ten percent of the marks for the test. While the student may not stay strictly with this limit, it is worthwhile that the student knows how many minutes should be spent per percentage point on the examination. Following this guideline gives students a sense of progress and responses to how they are doing. Next, the student should scan the test and answer the questions that are known first. That is a great confidence builder. Panicking throws off the students' concentration for the rest of the test. It is therefore important for the students to keep track of time so that they will have an opportunity to answer all questions. With many grading schemes, it is better to give a 75% answer on all questions than perfect answers on 50% of the exam. The student should not rush to hand the paper in. If all questions have been answered and there is still time left, the student should use that time to check the answers they have written down.

There are two generalized theories for anxiety. These include Psychological and Biological. The biological theory insists that there is increased activity of the brains' neurotransmitters. The psychological theory claims that anxiety is a signal that an unacceptable drive or impulse (such as aggression or sex) is surfacing which arouses the individual to prevent its expression unconsciously. The symptoms are seen as an "incomplete containment, or 'repression' of the unacceptable drive." Cognitive psychology approaches have emphasized faulty and distorted thinking patterns that precede expression of anxiety symptoms.

3 Methodology

The methodology for this project had three phases. Phase I, Site Assessment, consisted of meeting students and teachers and observing classes. We found it necessary to met with the students and teachers during the first phase of the project in order to get acquainted to them and also introduce them to our project and find out what they think of it. To get an idea of how the teachers teach the students, we observed classes. Through the observation of the classes, we were better able to teach the students using familiar terms and their methods of teaching and learning. Phase II, Accessing the Effectiveness of Technology, consists of determining if there is a possibility that technology will work in this environment. During this phase, we used different forms of technology, including graphing calculators and software applications to determine how effective they would work in their mathematics curriculum. Phase III, Sample Chapter Development involves the development of a format for a textbook that will be beneficial to the students and yet easy for the teachers to follow. This textbook was custom made for the BVI High School. During this phase we also took into account potential problems and disabilities that affect some students. Phase IV, Conclusions and Recommendations, was the final phase during which we will presented our sample chapter to the school along with the recommendations we had concerning their math curriculum and their style of teaching.

5.6 Phase I - Site Assessment

During Phase I, we collected the background information needed to understand how technology could be appropriately utilized. In order to assess the site properly, we found it necessary to:

- Obtain teachers' and students' opinions on technology in education
- Observe the teaching style of the instructors
- Critique the mathematics curriculum
- Determine the limitations set by the school administration and government concerning the educational curriculum
- Determine the teachers' and students' familiarity with technology
- Determine the feasibility integrating the technology

5.6.1 Meetings with Teachers as a Group

Our first contact with teachers was an informal meeting to introduce the project and ourselves. At this meeting, we gained an idea of how the teachers and administration felt about the project introducing technology into their educational system. We had the teachers discuss their views about teaching students. During this meeting, we gained the trust of the teachers and the administration. We let the teachers know that their opinions will be included in every aspect of the project and we set up individual meeting times with the teachers.

Methods:

To achieve our goal at the first meeting, we used Microsoft PowerPoint to make a presentation on our project. At this time, we addressed any questions or concerns of the teachers, such as questions or opinions on our project. We also were able to gain information on the kinds of technology they currently use as well as what technology they would like to use. Demonstrations were performed to show the ease of use and effectiveness of the proposed technology. We also obtained a better understanding of how they make accommodations for students who have difficulty understanding classroom lessons.

5.6.2 Class Observations

While sitting in on classes, we paid close attention to the teachers' teaching styles. Questions we will try to answer include the following:

1. How does the teacher present material to the students?
2. Does the teacher offer students a chance to ask questions?
3. Is the teacher prepared for the class?
4. Is the teacher organized?
5. Does the teacher call on students periodically throughout class?
6. Does the teacher use visual aids? If so, what types of visual aids?
7. How is the class arranged (location of teacher relative to students)?
8. What type of hand and body language does the teacher use?
9. Is the teacher capable to keeping the students' attention?
10. Does the teacher care about the welfare of the students?
11. How does teacher apply the information to real life?

We will use the answers from the questions to remove any erroneous preconceived notions. This will allow us to talk from experience and back up any conclusions we may draw. At this time, we will also make note of the teachers' strong and weak points to locate possible areas of improvement.

5.6.3 Critiquing the Curriculum

In this part of Phase I, we reviewed the mathematics curriculum taught to the students. We looked at the curriculum in terms of breadth of topics covered, its goals, and how it addresses different ability levels. This informed us of the depth to which the teachers are expected to for into each topic of the curriculum. Knowing this, we were better able to write a book that accounts for topics that were found by us to need more time and stronger explanations.

5.6.4 Limitations and Feasibility

In this step, we interviewed school administration and government officials to determine restrictions on changes in the curriculum. We also conducted a feasibility study, taking into account the cost of the different technologies and space limitations. We used this information to form recommendations that best suit the needs and capabilities of the British Virgin Islands.

5.7 Phase II - Accessing the Effectiveness of Technology

During Phase II, we took two classes, one containing average to above average students and one containing below average students. Each class was divided in half, one half from each worked with us as the experimental groups, and the other halves remained with their regular teacher, as the control groups. We taught the students in the experimental group the same topics they were currently studying, using technology, and compared their test scores to the students in the control group, without technology. The head of the mathematics department designed the assessment examination for both groups of students. It was designed in such a way that, it covered all the materials that the students were expected to know within the period of time we taught them regardless of how far we got. The head of the mathematics department graded the examinations.

5.7.1 Meetings with Teachers

At this point, we began meeting with teachers to introduce and teach them some of the math-related technologies. We stimulated the teachers' interests in technology, and gave the teachers the necessary skills to incorporate technology into their teaching styles. Here we also discussed their opinions on technology in education. We were able to find out what they really thought, once they did not have the pressure of being around their peers. At this meeting, we learned about the various teaching styles used by these teachers. We also gained an insight on their feelings about implementing technology into their educational system.

5.7.2 Follow up Meeting with the Head of the Mathematics Department

During this meeting, we discussed the observations that we made during the previous weeks and some thoughts and opinions that we heard from the students and other teachers. We also started to discuss the course plan and the examination that will be used to assess our teaching methods. The objective was to ensure that the conclusions drawn during the site assessment phase were valid and unbiased.

5.8 Phase III - Sample Chapter Development

Due to the integrated nature of their curriculum, it was impossible to find a textbook that is capable of suiting the needs of the British Virgin Islands High School. At this point, we worked in cooperation with the teachers to develop a sample chapter for a textbook that demonstrated a format which the teachers could continue to work with. This sample chapter was developed not only to contain information about the topics that are to be covered but also to also assist with dealing with students who have difficulties and disabilities.

It is important that the material that is presented in the chapter be concise yet provide enough information to allow for successful learning. Because we worked with the teachers, we did not misinterpret the material. We got a consensus of their comments, and narrowed a list of problems to: student behavior, test-anxious students, and improper background with the learning disabled and handicapped

In order to determine the success of the project we need to ask: were we successful in developing a curriculum that addressed the problems the teachers found throughout their years of teaching, while also teaching for the CXC examination, the backbone of the current curriculum? Now that we have a list of what the teachers feel are problems, this question can be answered.

5.9 Phase IV –Recommendations

Phase IV is the phase during which the project group met to discuss which areas we felt need improvement. We presented our sample chapter to the school along with recommendations concerning their math curriculum.

6 Results and Analysis

This chapter will examine the results and observations made during the project in the British Virgin Islands. These observations include a critique of the current textbooks, the current math curriculum, and observations made during staff meetings and class lectures. Included in this chapter is research completed following the redirection of the project. These observations are the preliminary step to developing the recommendations.

6.1 Onsite Observation

The campus is composed of over two dozen buildings. The latest addition is a building erected in 1994 to accommodate for the increase in the school-aged population of Tortola, which doubled from 1968, when the campus was started, to 1998. Currently the high school staffs 115 teachers, with a male to female ratio of around 2:3.

The BVI High School, in Tortola, is the only high school on the island, though there are two others, one on Anegada, and another on Virgin Gorda. Virgin Gorda expects 30 students to graduate this academic year, and Anegada expects one student, while Tortola will have over 160 graduates.

Elmore Stoutt feels he is an "operating manager" because the campus is too spread out. He believes the education system is a "centralized system," where the department of education and ministry of education make the major decisions for the school, its staff, and students. Some of the problems he feels are being ignored are paying attention to those students who are gifted, and re-working the grading system of the high school.

The school has begun to create a "comprehensive education," by introducing a Crafts Design Technology Program (CDT) which allows those students who do not intend to continue their education a chance to gain experience in technical fields. Contrary to the common American system, the comprehensive system introduces topics in a very broad manner. Throughout the students' high school career, topics are reviewed three or four times in an attempt to familiarize the students.

The school enforces a uniform code in which the males must wear navy blue pants and light blue short-sleeve button shirts. The females must wear the same shirt, with a navy pleated knee-high skirt. Many students feel the uniforms take away from their sense of individuality and creativity, though they understand the reason behind the dress code. It is difficult to assess whether or not the uniforms have some bearing on the success of students or their discipline.

6.2 Analysis of the Current Textbooks

The current textbook used by the fourth form classes is called Oxford Mathematics for the Caribbean 4: Examination Level. The book is not meant to be read for immediate understanding. With very little explanation and a great deal of problems, the text seems to act more as preparation for the CXC examination rather than preparation for post-secondary education.

At the start of most chapters, there is a cartoon abstract to introduce the topic. These cartoons include some kind of parody or pun, and many times a real life application of the subject material.

The text is broken into three parts. Part I, Basic Syllabus, is used by classes in which the students intend on taking the Basic CXC examination. The second and third parts of the book are called General Syllabus. These sections are covered if the student intends on taking the General CXC examination.

The General Syllabus is comparatively more difficult than the Basic Syllabus, though each syllabus covers identical material. There is no obvious order to the textbook; it begins with Sets and Functions and continues with Computations Measurement. Statistics and Probability then follow, with the conclusion focusing on Transformations and Trigonometry.

6.3 Analysis of the Current Curriculum

The Caribbean Examination Council is an examination board that writes a detailed syllabus and an examination that is used to access students at the end of their high school education. The Caribbean Examination Council just gives a list of topics that they think are necessary for the student to know upon graduating from high school. Although the syllabus from the Examination Council and that written by the school have listed similar objectives, the school syllabus is more detailed than that given by the Caribbean Examination Council. This suggests that although the teachers use the syllabus designed by the Examination Council, they are able to add new topics to the syllabus, as long as the students are taught what they are supposed to know. This suggests that the Caribbean Examination Council does not way influence the way that the teachers teach the classes. The curriculum developed by the school, however, does not provide the teachers the freedom to teach with their various teaching styles. The syllabus tells the teachers exactly what to do during each class time. This obviously puts some students at a disadvantage. With the broad integrated curriculum designed by the examination board, it seems that there is not enough time for the teachers to cover all the materials expected of the student after high school. Unfortunately, with the textbook currently being used, the student just has access to several questions with no explanations. The curriculum is set up such that the topics are integrated. Unlike in the United States where a student can take geometry for an entire year, in the BVI High School, there is no such thing. The integrated curriculum does not give students a solid foundation in any one topic.

In conclusion, it is evident that the curriculum is too broad, although it has the advantage of introducing the students to a wide range of topics. The students come out of the system knowing which areas they are interested in but when they go onto college they are slightly behind the average student from the United States. It is also apparent that the high school believes in learning by going through numerous examples, which is a widely accepted concept, but they need to obtain and use a book that gives the student some additional instruction.

6.4 Observations of Staff Meetings

The mathematics department staffs 14 teachers with only about 30% male. Following the initial meeting, any concerns of the teachers were immediately addressed in a question-and-answer session. Unfortunately, there were very few concerns, while the few questions that were asked pertained mostly to personal issues of the project members, such as our majors, home locations and ages. Because the staff seemed more attracted to our background and less attracted to the project, we can conclude that there was a general lack of interest with the staff.

From the first staff meeting with all the high school staff, we saw that there is an obvious problem with student discipline. This most likely stems from lack of control and authority on the parents' behalf and partly due to the lax atmosphere created around the school environment. The principal has a lot of hope that the problem can be quickly resolved within the next academic year, following the inauguration of the new government officials.

6.5 Observations of Classes

We were able to attend several classes taught by different teachers at the school. During these class periods, we were able to observe valuable information about how the teachers use classroom time, their classroom arrangements, and note other useful information.

After we sat in classes, then observation of a student discipline problem was evident. After only a few minutes into each class period, the students became less attentive to the instruction given by the teacher and more involved with distractions. One cause of this poor behavior could possibly be the seemingly lack of authority that many of the teachers seemed to have. The teachers often did little to control these distractions, and sometimes they did not even notice them. It seemed that the low-performing students were involved more easily with the distractions, however even the high performing students became involved with these distractions after a while, and were not able to concentrate as well on the teacher's instruction.

The teachers seemed to use the blackboards effectively and often. The teachers we observed called students to the boards to try problems, yet often ended up doing out most of the problem without allowing the students to learn their own way by themselves. During class time, the teachers seemed to balance lecture and example problems well. When example problems were done, they were explained well. In the classes we observed, none of the students or teachers used any forms of technological equipment, including calculators.

Often times, the teachers give few gesticulations, which inadvertently appeared to create some type of imaginary boundary between themselves and their students. Some of the classrooms are in disorder; there is no order to desk arrangement, allowing the mischievous students to hide their wrongdoing by sitting in the back or out of the direct view of the teacher.

6.6 Interviews with Math Staff

We came out of the interview process with the teachers having gained a lot of insight about their backgrounds and with excellent first source information about the mathematics department and their curriculum. We also gained information to help us learn where technology could properly be used in their curriculum. We were even able to ascertain the teachers' feelings on technology and where they believe trouble could be encountered when attempting to implement it in their curriculum.

Teachers at BVI High School have been teaching for an average of 19 years. We learned that most of the teachers do not attend a college or university in the United States. Most attend in Britain, in the British Virgin Islands, or in the West Indies.

Many of the teachers feel that technology in the school is very worthwhile for the students. Their only complaint is that technology, in their minds, is time consuming to learn, and that a lot needs to be learned by the teachers. All of the teachers use scientific calculators in their classes, however none use scientific calculators. Some other teachers use the computer labs occasionally. A few teachers use overhead projectors in their classes.

The teachers felt in general that there would be a number of problems with implementing technology in the classroom. They felt that there is a lack of accommodations for the equipment, which would require additional building space. They also felt that the amount of initial training necessary for the students and teachers combined with the fact that they would all have to keep up with new technologies, would be an extensive effort. The teachers also felt that another issue is attempting to get necessary funding.

As for strengths and weaknesses of the curriculum, the teachers in general agree that the curriculum is geared toward the CXC exam. Another consensus is that the teachers here do not like the American style of teaching mathematics. Specifically, the teachers do not like spending one year on a topic, such as one year devoted to geometry, a year of algebra, a year of pre-calculus, etc. They prefer to teach a little bit of each every year. The staff members debate over whether or not the curriculum is interesting or not to the students.

The teachers were asked which forms they find most difficult to work with. The most common response was form-2 students, followed by form-4 students. These would be students in their second and fourth years of high school. The form-2 student difficulty is commonly associated with the fact that these students are no longer the freshmen in the school and some have learned what they can do to just get by in their classes. Others have learned just what it takes to get in trouble and extend their actions to that line, but do not cross over. The disciple problem with form-4 students is attributed to the fact that these students are almost out of high school. These students also have to take the CXC examinations in their fifth year of school. The form-4 students seem to pay less attention in class than the other students and care less than the other forms about their education. The teachers claimed that this year's form-4 students were more difficult than usual, with the reason being unknown.

As for other challenges of being a teacher at BVI High School, the teachers commented in general that discipline is a problem. There was an attack on a teacher during our stay at the school. There are also various illegal activities occurring with the students at the school that the teachers are concerned about. These issues do not represent a major problem at the school at this time, but the teachers want to prevent any problems from occurring.

The teachers were questioned about what they considered difficult topics to teach to their students. These issues ranged quite a bit from algebra and symbols, models, geometry, transformations, and rotations. The most commonly stated topic was algebra. The teachers seemed to think algebra was a difficult topic to teach because it is taught to the form-1 students, or first year high school students. The students supposedly have a difficult time learning different symbols, variables, and learning the basics of algebraic equations. At the same time, these students are adjusting to their first year of high school as well.

We also asked the teachers about their thoughts in general on our project. The majority of the teachers were pleased with our project, and believed that its intentions are positive and could really help the school. Many of the teachers hoped that our project would allow for more calculators, computers, and other technological equipment to be introduced to the school.

6.7 Results of Technology

Pupil teaching was down over a four-week period. During this time, students were encouraged to explore computer software and graphing calculators. Eventually, this led to the integration of these technologies in our daily curriculum.

From our assessment tests given to our students and to the control student, it was evident that our student's performances were substantially higher. These scored cannot reflect which technique of teaching, with or without technology, is better, because there was only one assessment.

Many of the students did not have prior computer background; therefore, more time was spent teaching the students basic computer skills. Had these skills been taught throughout their grammar school career. It is our opinion that once these skills are developed, easy an swiftness with computers will become more occurring thus allowing for a quicker understanding of the material taught. It was interesting to note the difference between the high school students of the BVI and those of the United States.

7 Recommendations and Conclusions

This is the final chapter, giving a brief summary of the events of our stay. This chapter will also explore recommendations for a number of problems addressed throughout the project. The recommendations chosen are the most suitable for the issues at hand.

One issue we noticed during our time at the high school is that there are no programs for the learning disabled, no measures to help the low-performing students, and no ways to enhance the study of the gifted students. At the general meeting with the teachers, a few commented that they believe there are some students who need special instruction to help increase their performance. However, nothing is done to address this need. During our time teaching the students, we also witnessed students who seemed to be very anxious about their tests. A few of the students we taught did not want to show up to take the test simply because they hate taking tests. Also, when we observed the test being taken, many of the students seemed quite nervous. Our project has addressed this need by including detailed instruction about assisting learning disabled and low-performing students, and students who may experience test anxiety.

Another issue is that there are some student behavior problems at the school. Some students have begun resorting to violence and illegal activities. The school has seen these problems increase over the past school year. One possible cause for these issues is that the students do not have enough avenues to pursue in the school. This was raised by some of the teachers at the general staff meeting. Another possible cause is that the students do not enjoy learning material the way it is currently taught. During our class observations, it seemed that many of the students were not interested in the lecture and did not pay attention. We hope our project will provide an avenue of interest to more students by exposing more of them to computers. Our project goal was to create an innovative textbook to be used by the students, with a purpose of increasing the interest in their studies. We also hope that some programs are implemented to help keep students on the right track in their studies and in their lives.

Also observed is that there is not enough use of the existing technology. There are two computer labs at the school with a few dozen PCs each. These labs are used only by a small percentage of students who are studying information technology. Therefore, a large portion of the student body does not learn how to use the computers. Our project addressed this issue by evaluating whether or not students are able to learn material at the same time as learning new technology. During our time teaching the students, we found that students learn better if they are first exposed to the new class material, then are exposed to the technology later. In this case, the technology is used as a tool to re-enforce the students' knowledge of the material. Also, the students at the same time will learn how to use the new technology. In the student textbook that we created, we have included technology labs in an effort for the students to use the computer equipment in the school in their math classes. Our goal is for the existing technology base to be used by a larger percentage of the student population. We also hope that the school will take measures to train as many students as possible on using the computers.

The textbook currently used by the British Virgin Islands High School is called Oxford Mathematics for Caribbean 4: Examination Level. The book is not meant to be read with immediate understanding of subject material. The text provides little explanation and is complemented by a few problems, usually less than 20 questions per topic. This text appears to be solely used for the preparation for the Caribbean Examination Council (CXC) examination, an aptitude test administered during the conclusion of the academic year.

The CXC examination can be compared to the United States's SAT. With improper focus, the students are seemingly ill prepared for post-secondary education or any number of technical job fields they may pursue following high school. Though this is debatable and no test assessments have been made to support this opinion; one-on-one interactions with these students have suggested that their lack of discipline has an impression on the material they retain.

It is important to understand and work with modern technology. Students planning to continue their education, or join the workforce following high school, will have a drastic advantage if they have some background knowledge of technology, specifically computers, computer programs, calculators and how to apply these technologies to real life situations. Unfortunately, the mathematics curriculum does not provide adequate reinforcement of any kind of computer laboratories. We found that students who use technology to supplement teacher instructions scored higher on their examinations that students who did not use technology. We also found that the more familiar students became with the use of computers, the more they would consider studying technology in college or as a future career.

The goal of the project was to develop a format for creating a textbook that would be specifically tailored to the problems listed above as well as problems the administration feel need to be addressed. The textbook will present solutions to providing proper preparation for the CXC examination, adequate computer laboratories, in-depth explanations on the math topics, as well as enough problems for students to accurately assess their retention of material.

The textbook will also integrate technology, new approaches to teaching and address different learning styles. Another goal of the project was to help the teachers understand and use technology. With these goals in mind, we hope to increase students interest in their studies and expose more students to computers.

In our study, technology proved to be a very critical resource that must be part of education. Using graphing calculators, students will be preparing themselves for using them to go on to study advanced topics such as engineering. Computers can be used to help students learn many educational subjects by allowing hands-on interaction.

Recommendation 1:

The BVI High School currently has no "special needs" programs, and only one teacher that specializes in these kinds of problems. The principal of the school feels that another problem is trying to accommodate for gifted students, as they cannot meet their potential because they are being held back by unnecessary repetition, or rudimentary topics. **We encourage the Department of Education to provide proper background training for teachers who deal with gifted and low-performing students.** This training should include education with Attention Deficit Disorders (A.D.D.), mental handicaps, child prodigies, and various types of anxieties that students encounter during every-day school life. It is imperative that every student be given a chance to prove himself, and often, the student may just need an appropriate outlet to produce favorable results.

Recommendation 2:

In response to the principal's call for help with the student discipline problem, **we recommend a peer leadership program should be implemented which will serve as a tutor program as well as a mentor program.** This program can be after-school, thus keeping problem students off the streets and keeping drugs, alcohol and guns out of their hands. This can be a volunteer program, where the staff is made up of volunteers from the community. In theory, each staff worker will be a mentor for a group of students, providing positive reinforcement with academics and extra-curricular activities. It is suggested that each staff worker have at least a high school degree, because this after-school program can also serve as a tutor service so the students that are having difficulties with their schoolwork can get help. It is optional, but if the program works with young students two or three years prior to entering high school, then the high school students can be the staff workers.

Recommendation 3:

Our third recommendation, and the most important, is that **teachers continue our work by finishing the textbook**, thereby addressing any problems we may not have come across. The textbook has provided enough flexibility for teachers to take the textbook into another direction without destroying the fundamentals of its development. We encourage teachers to continue to make amendments to the textbook, tailoring it to their specific needs. A copy of the teacher's manual, student's manual, and the problem workbook will be provided on CD-ROM, allowing teachers to copy any of the three books to their computer and later remove anything they feel unnecessary or add anything they feel important but not mentioned.

In order to provide a Teacher's Manual that is made to the specifications of the BVI High School, years of research and investigation are needed into the Math

Department, curriculum, and the examination requirements. We regret to say that our two months was not sufficient to produce documentation for a whole textbook, therefore we completed a portion of the manual we feel is a good representation of our work and a good reflection of the material we would like covered in the completed version of the Teacher's Manual. The finished version of the Teacher's Manual should include notes to the teacher on proper approaches using technology, dealing with learning difficulties, and helping students recognize patterns and improve estimation skills.

Recommendation 4:

We recommend the implementation of a program that will improve computer and technology literacy with students and teachers. This program can be an extension to the after-school program mentioned earlier or can be a completely new program. It has been seen first hand that the computers at the school were used for nothing more than word processing and computer games, it is suggested that the games be removed from the terminals. **As an amendment, we suggest the math department try to use computers and calculators to reinforce math concepts**. This type of reinforcement will allow students to prove their retention of material as well as their grasp of computers and computer programs. **Another way to improve computer literacy is to allow weekly or biweekly laboratories**; the math students go to a computer lab and work with mathematics software that will again, reinforce the concepts they learn in the classroom.

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A fresh look at...
FORM 4 MATHEMATICS
for the
British Virgin Islands High School

STUDENT TEXTBOOK

by Edith Ampadu, Bill Burgess,
Jason Cobb, and Aaron Lopez.

1 CHAPTER ONE: Computations and Numbers

1.1. Review of calculations with fractions

A fraction is a number that can be expressed in the form a/b or $\frac{a}{b}$.

- A fraction can also be defined as: $\frac{\text{part}}{\text{whole}}$, $\frac{\text{section}}{\text{whole}}$, or $\frac{\text{sum}}{\text{all}}$.
- The top number is the numerator, and the bottom number is the denominator.

$$\frac{\text{numerator}}{\text{denominator}} = \text{numerator} \div \text{denominator}$$

- Fractions express division.

$$\frac{5}{8} = 5 \div 8$$

- Equivalent fractions are fractions that have equal value. The following are equivalent fractions:

$$1/2 = 2/4 = 4/8 = 8/16 = 16/32 = 32/64$$

$$2/3 = 4/6 = 8/12 = 16/24 = 32/48$$

$$3/5 = 6/10 = 12/20 = 24/40 = 48/80$$

1.1.1. Addition and subtraction

- In order to add or subtract two fractions, the denominators must be equal. If the denominators are not equal determine the *Lowest Common Denominator* (LCD). To determine the LCD, make a list of the multiples of the denominator of each fraction, and select the lowest number that is in common. Remember that the LCD is never greater than the product of the two denominators.
- Multiply each fraction by an appropriate form of 1 so that all denominators are equal to the LCD.
- Add or subtract numerators. (The denominator is the LCD.)
- Reduce if possible.

$$\frac{1}{2} + \frac{7}{8} =$$

Step one:
Determine what the lowest common denominator is.

LCD = 8

Step two:
Multiply each side of the equation by the appropriate form of one in order to get the same denominator for both fractions.

$$\left(\frac{4}{4}\right)\frac{1}{2} + \frac{7}{8}\left(\frac{1}{1}\right) = \frac{4}{8} + \frac{7}{8}$$

Step three:
Add or subtract numerators as normal.

$$\frac{4}{8} + \frac{7}{8} = \frac{11}{8}$$

Step four:
Reduce if possible

$$\frac{11}{8} = 1\frac{3}{8}$$

1.1.2. Multiplication

To multiply fractions, multiply the numerators, multiply the denominators, and place the product of the numerators over the product of the denominators.

$$\frac{4}{5} \times \frac{15}{16} = \frac{4 \times 15}{5 \times 16} = \frac{60}{80} = \frac{3}{4}$$

Try some for yourself:

A) $\frac{1}{8} \times \frac{3}{5} =$

B) $\frac{7}{9} \times \frac{6}{8} =$

Here is a harder example:

$$2\tfrac{3}{4} \times 1\tfrac{1}{2} = \frac{11}{4} \times \frac{3}{2} = \frac{(11 \times 3)}{(4 \times 2)} = \frac{33}{8} = 4\tfrac{1}{8}$$

1.1.3. Division

To divide a number by a fraction follow the steps in this example:

change division to multiplication

$$\frac{4}{5} \div \frac{8}{9}$$

$$\frac{4}{5} \times \frac{9}{8}$$

change the divisor (the second number) into its reciprocal

use cross reduction to make multiplication easier.

$$\frac{\cancel{4}^{\,1}}{5} \times \frac{9}{\cancel{8}_{\,2}}$$

make sure answer is in simplest terms

$$\frac{9}{10}$$

1.2. Review of calculations with decimals

The decimal system and decimals are based on tenths or the number 10.

- The digits to the right of the decimal point are called decimal fractions.
- The decimals that do not have digits to the left of the decimal point are written 0.95 or .95. To make it easier for the reader, it is suggested to write these decimals with a zero to the left of the decimal. This helps the reader notice that the number is a decimal, as opposed to a whole number.
- The digits to the right of the decimal point correspond to tenths, hundredths, thousandths, ten-thousandths, hundred-thousandths, etc. For example, the digits in the number 59.75498 correspond to:

  5 → tens, 9 → ones, 7 → tenths, 5 → hundredths, 4 → thousandths, 9 → ten-thousandths, 8 → hundred-thousandths.

- The decimal point is always present after the ones digit, even though it may not be present. For example:

  7=7.0=7.00=7.000=7.00000=7.0000000

  29=29.0=29.0000=29.000000=29.0000000000

- Proper names that correspond to decimal fractions are used to describe measurements or quantities in various units, such as grams, seconds, liters, meters, etc. For example, if a scientist is measuring extremely small amounts of a chemical in grams, proper names for the following decimal quantities are:

0.1	10^{-1}	1 decigram
0.01	10^{-2}	1 centigram
0.001	10^{-3}	1 milligram
0.000001	10^{-6}	1 microgram
0.000000001	10^{-9}	1 nanogram
0.000000000001	10^{-12}	1 picogram
0.000000000000001	10^{-15}	1 femptogram

1.2.1. Addition and subtraction

Add zeros to the decimals until all the numbers have the same number of decimal places. Line up the numbers and start adding them up from right to left ignoring the decimal places.

Place the decimal point in the answer so that it lines up with the number being added or subtracted i.e. 4.36 + 7.2 + 6.314

$$\begin{array}{r} 4.360 \\ 7.200 \\ +\underline{6.314} \\ 17.874 \end{array}$$

1.2.2. Multiplication

In order to multiply decimal numbers, multiply as though there are no decimal numbers. Move the decimal from the right of the product the number of places equal to sum of the number of places of the numbers being multiplied.

<u>Example</u>:

$3.\underline{14}$ x $2.\underline{6}$
3 14 x 2 6 = 8 164

therefore, the result is $8.\underline{164}$.

1.2.3. Division

When dividing a number by a quantity containing a decimal write the problem in standard form. Next move the decimal in the divisor to the right such that the divisor is a whole number, noting the number of places moved. Move the decimal in the quotient to the right an equivalent number of places adding zero place holders if necessary. Next copy the decimal directly up above the division symbol. Divide as normal. The answer will contain a decimal in the correct location.

<u>Example</u>:

$$\boxed{\begin{array}{r} ? \\ 0.5\overline{\smash{)}10} \end{array}}$$

$$\begin{array}{r} ? \\ 5.\overline{\smash{)}100.} \end{array}$$

Step One:
Move the decimal point in the divisor and the dividend to the right until there are no digits to the right of the decimal point in the divisor, inserting zeros as required.

$$\begin{array}{r} 2? \\ 5.\overline{\smash{)}100.} \\ \underline{10} \end{array}$$

Step Two:
Divide 5 into 10.

$$
\begin{array}{r}
2?.\\
5.\,\overline{\smash{)}100.}\\
10\\
\hline
000
\end{array}
$$

Step Three:
Subtracting 10 from 10 results in 0. Then bring down the last zero from the "10**0**".

$$
\begin{array}{r}
20.\\
5.\,\overline{\smash{)}100.}\\
10\\
\hline
000
\end{array}
$$

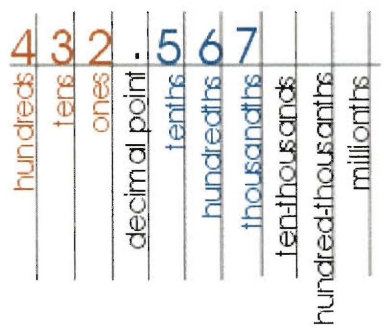
Step Four:
There is nothing for 5 to divide into, so place a zero above the last zero in the dividend.

Therefore, $10 \div 0.5 = 20.$

1.3. Convert a fraction to a decimal and vice versa

Place Value

Example: 432.567
The 2 is in the ones place.
The 3 is in the tens place.
The 4 is in the hundreds place.
To the right of the decimal place...
The 5 is in the tenths place.
The 6 is in the hundredths place.
The 7 is in the thousandths place.



The number is read as:
"Four hundred thirty-two and five hundred sixty seven thousandths."

The relationship between this decimal and its corresponding fractions:

$\frac{5}{10}$ = 0.5 = Five-tenths

$\frac{56}{100}$ = 0.56 = Fifty-six hundredths

$\frac{567}{1000}$ = 0.567 = Five hundred sixty-seven thousandths

- As you might have guessed from the definition of a fraction, the dividing of the numerator by the denominator results in the decimal equivalent for a given fraction.

- To convert a decimal to a fraction, just read the decimal as if it is a whole number adding the suffix for the smallest place value reached by the decimal. For the example above, thousandths is the smallest decimal place reached by the decimal.

1.4. Round off numbers

To round off decimals, the last retained digit should either be increased by one or left unchanged according to the following rules:

- If the leftmost digit to be dropped is less than 5, leave the last retained digit unchanged.

- If the leftmost digit to be dropped is greater than or equal to 5, increase the last retained digit by one.

<u>Example</u>:

5.4	rounds to	5.
2.5	rounds to	3.
45.64	rounds to	46.

To round off to a certain number of significant figures, ignore all zeros and start counting from the first integer taking into account all numbers including zero thereafter, until the number of significant figures is obtained. If the number after the last number required is greater than five, add one to the last number.

i.e. 0.024 to 1 significant figure is 0.02.

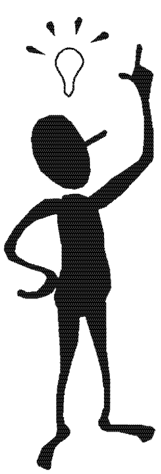
1.5. Review of rules for indices

The following rules of indices explain how to work with numbers containing exponents.

1. $a^n \text{ x } a^m = a^{n+m}$
2. $a^n \div a^m = a^{n-m}$
3. $a^o = 1$
4. $a^{-n} = 1/a^n$
5. $(a^n)^m = a^n x^m$
6. $(a/b)^{-n} = (b/a)^n$

1.6. Standard form

Example of how to write in **Standard Form**



$$4\ 792\ 000. = 4.792 \times 10^6$$

the decimal point has
moved 6 places

Use the following steps to write a number in standard form:

1) Working from left to right, insert a **new** decimal point after the first nonzero digit in the number.
2) Round the new number off to the number of places for desired accuracy. Write " x10 " after the rounded number.
3) Count the number of places the decimal moved from its **new** location to the **old** location. When counting from left to right, this value is positive, if counting from right to left, this value is negative.
4) Write the value you calculated in the previous step as the power to which 10 is raised.

1.7. Errors in measuring

When making measurements, it is important to note the greatest possible error. Some measurements will need to be very precise, while others need not be so exact. Knowing the greatest possible error will allow you to determine if your result is valid enough for what you are measuring.

The greatest possible error is based on how numbers are rounded. If a number is rounded to the one decimal place, the greatest possible error is +/- 0.5. If a number is rounded to two decimal places, the greatest possible error is +/- 0.05. If a number is rounded to three decimal places, the greatest possible error is +/- 0.005. Therefore, the more precise you want to be, the more decimal places you need to use.

Look at the following table:

Original No.	Rounded To	# Decimal Places	Error	Greatest Possible Error
9.4	9.0	1	-0.4	+/- 0.5
9.5	10.0	1	+0.5	+/- 0.5
9.54	9.50	2	-0.04	+/- 0.05
9.55	9.60	2	+0.05	+/- 0.05
9.554	9.550	3	-0.004	+/- 0.005
9.555	9.560	3	+0.005	+/- 0.005

1.8. Degree of accuracy

The degree to which a number is accurate depends on the number of decimal places to which it is written. A number written to a higher number of decimal places is more accurate than one written to a fewer number of decimal places. With a list of numbers, the set is as accurate as the least accurate term. For example, if you have (2.5cm, 2.62cm, 2.7cm), 2.62cm is the odd one out, meaning that 2.62cm is more accurate than the other two measurements. However, when these numbers are being added, the members of the list must be written to the same number of decimal places as the least accurate term. For the previous example, the numbers added would be 2.5cm+2.6cm+2.7cm, totaling 7.8cm.

1.9. Base Numbers

As you most likely already know our number system is based on ten. If you take a moment, you should be able to explain why. **You got it --** we have ten fingers, on which you probably originally learned to count and do math. But for some reason a few other cultures in the world decided to base their number system on things other than one. That is how base numbers first came into existence. Now that we are entering the computer era, however, people have noticed that computers and machines understand other number systems much easier. You might already know of a very popular one, binary, that's the number system with just ones and zeros. This makes sense since it is easier and faster for a computer to think in just ones and zeros or on and off.

1.9.1. Convert from one base to another

When converting a number from a base other than 10 to base 10 is simple. To do this take the sum of each digit multiplied by the base raised to the exponent whose value is equal to place value of the digit. For example in base 5:

$$2414_5 = 2\times 5^3 + 4\times 5^2 + 1\times 5^1 + 4\times 5^0 = 359$$

In base 2:

$$1011_2 = 1\times 2^3 + 0\times 2^2 + 1\times 2^1 + 1\times 2^0 = 11$$

To convert a number from base 10 to another base, write down the starting value in the first column of the conversion table. Divide that number by the base. If the result is a whole number then write down the result in the result column and a zero in the remainder column. If the number does not divide evenly then write down whole number of the result in the result column and the appropriate remainder in the remainder column. Continue doing these steps writing down the results and remainders below the previous result and remainders until the final division leaving only a remainder. The final answer for the conversion is read from the remainder column read from bottom to top.

Example:
Convert 25 from base 10 to base 2:

number	result	remainder
25		

Here the number being converted is entered in the first column.

number	result	remainder
25	12	1

Here the base is dividing the original number for the first time. The result is 12 with a remainder of one. These values are entered in the appropriate boxes.

number	result	remainder
25	12	1
12	6	0

Here the same process is repeated once again by dividing the result by the base two again, this time resulting in a whole number with a remainder of zero.

number	result	remainder
25	12	1
12	6	0
6	3	0
3	1	1
1	0	1

This process is repeated until the final time when the result equals 0. The final answer is read from bottom up. Thus 25 in base 10 is equal to 11001 in base 2.

1.9.2. Add in bases

Adding numbers in bases other than ten is quite similar to adding numbers in base 10. When you add two numbers in base 10 you add the numbers as normal and if the result exceeds or equals the base (10) you carry 1, and add the remainder. When adding numbers in other bases you follow the same technique.

Example:
Adding in base 2:

$$\begin{array}{r}11\\+1\\\hline 100\end{array}\quad\begin{array}{r}101\\+10\\\hline 111\end{array}\quad\begin{array}{r}10\\+1\\\hline 11\end{array}$$

In base 3:

$$\begin{array}{r}2\\+1\\\hline 10\end{array}\quad\begin{array}{r}2\\+2\\\hline 11\end{array}\quad\begin{array}{r}21\\+22\\\hline 120\end{array}$$

1.9.3. Subtract in bases

Subtracting numbers in bases other than 10 is also very similar to subtracting numbers in base 10. When subtracting two numbers in base 10 you subtract as normal, unless in a particular column the number being subtracted from is smaller than the number being subtracted. In this case you borrow 10 from the base in the next column reducing it by one and adding it to the number being subtracted from, and subtract as normal. When subtracting in other bases you follow the same procedure.

Example:
Subtracting in base 4:

$$\begin{array}{r}21\\-3\\\hline 12\end{array}\quad\begin{array}{r}32\\-23\\\hline 3\end{array}$$

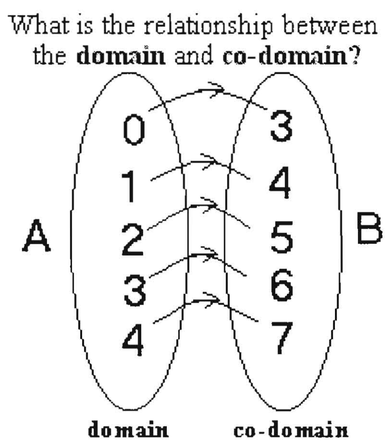
In base 5:

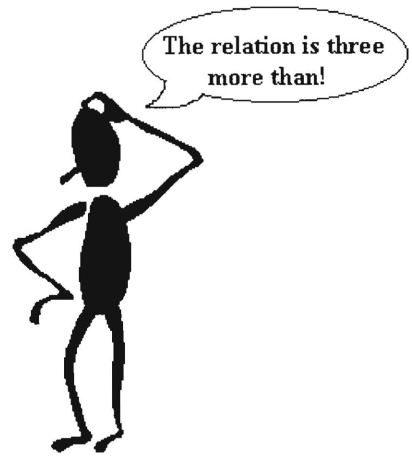
$$\begin{array}{r}21\\-3\\\hline 13\end{array}\quad\begin{array}{r}31\\-23\\\hline 3\end{array}$$

Mapping helps define the relationship between two sets of numbers.

2.1. Mapping Diagram

Mapping diagrams can illustrate this relationship. Here is an example of a mapping diagram.

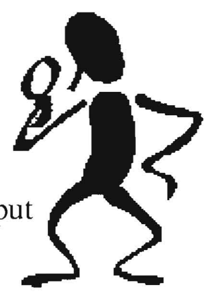




In the example to the left, set A is called the **domain** and set B the **co-domain** or **range**. This rule can also be written as a *number machine*. Take a look…

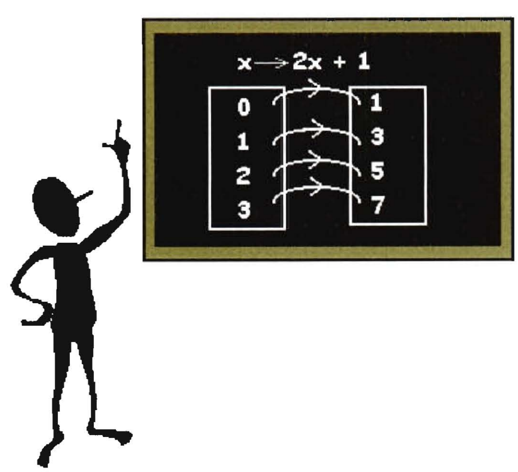
Input $\rightarrow \boxed{+3} \rightarrow$ Output

x $\qquad\qquad\qquad$ y



To simplify things, the number machine can be written as
$x \rightarrow x + 3$

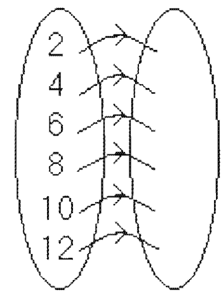
Try one for yourself. Draw a mapping diagram for the map $x \rightarrow 2x + 1$ with the domain {0, 1, 2, 3}.



Mapping diagrams is very useful when determining how a function affects a certain set of data. In order to draw mapping diagrams defined by a given rule, make each entry of the domain, "x". Then plug each value of x into the given function. Each result should be placed in the co-domain, exactly where the arrow points to from the entry in the domain.

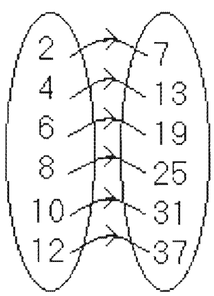
Look at the following example:

$x \rightarrow 3x+1$

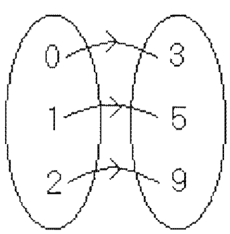


Simply plug each value in the domain into the function to give you each value of the co-domain. For example, plugging x=2 into the function yields 7. Plugging x=10 into the function yields 31.

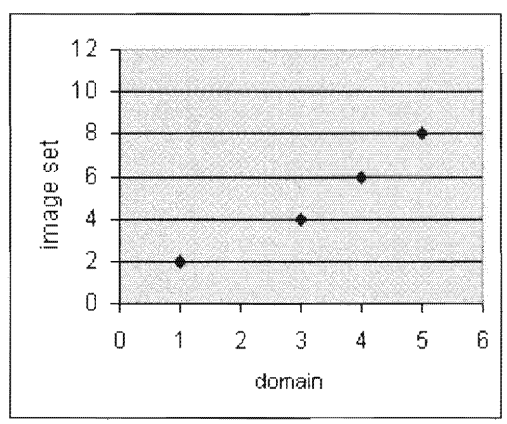
The completed mapping is:



To list the **image set** of a mapping, simply take the elements of the co-domain, and write them in a list form. The image set of a mapping can be determined from a graph or from a mapping diagram. Look at the following examples:



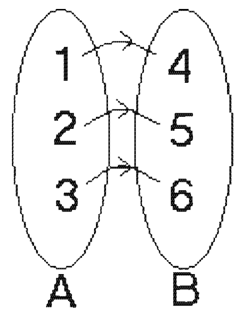
The image set of this mapping is simply made up of the numbers in the co-domain. The image set is (3,5,9).



The image set of this graph is simply made up of the y values. The image set is (2,4,6,8).

2.2. Rules of mapping

The **rule of a mapping** is the relationship between the domain and co-domain of a function. The domain is the set whose members map onto another function called the co-domain. To determine the rule of mapping, a particular group of ordered pairs must satisfy a common relation. In the following example, A is the domain and B is the co-domain.



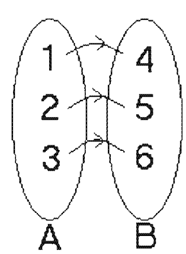
To determine the rule of mapping, find a relationship between the first member of the domain and the first member of the co-domain. Next use the relation developed, on the other members of the domain and co-domain to determine if it works for all members of both sets. In the example above, $1 \rightarrow 4$, a possible relation is "add three to the domain to obtain the image in the co-domain". This relation satisfies all members of the domain. Hence, the rule of this mapping is $A \rightarrow A + 3$

2.3. Types of mapping diagrams

There are four types of mapping diagrams:

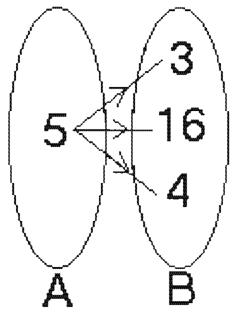
1 One to One

- This is where each value in one set maps to only one value in another set.



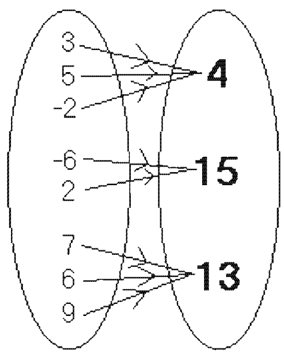
2 One to Many

- This is where each value in one set maps to more than one value in another set.



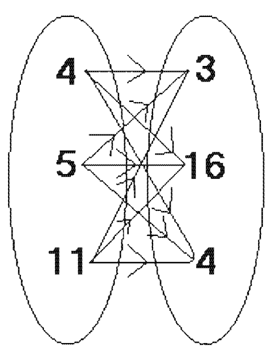
3 Many to One

- This is where multiple values in one set map to a single value in another set.



4 Many to Many

- This is where multiple values in one set map to multiple values.



3 CHAPTER THREE: Functions $f(x)=4x+2$

A **function** is defined as a mapping in which each element of the *domain* is mapped to one, element of the *co-domain.* There are two types of mapping diagrams that can be called *functions*, *one-one* and *many-one*.

The **range** consists of those elements of the *co-domain,* which map to at least one *domain.* The **image set** is a set of *range* values that satisfy the given function.

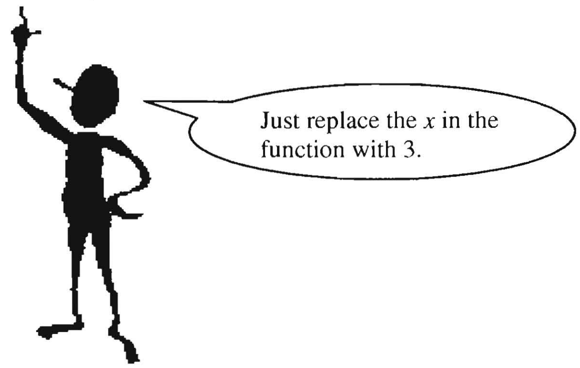
In the function:

$$f(x) = x^2 + 3$$

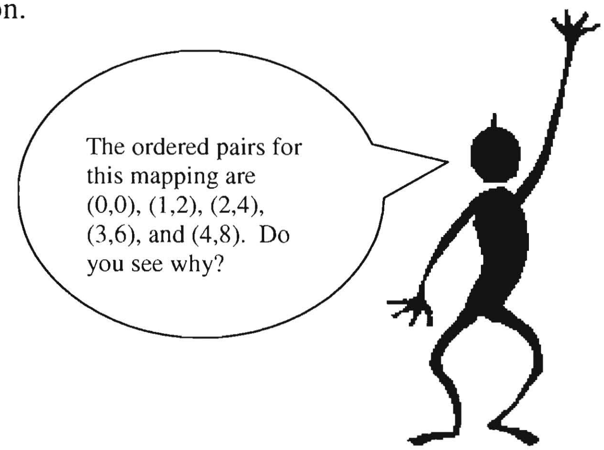
the *image* of 3 is 12. Do you see why? Try solving it algebraically…

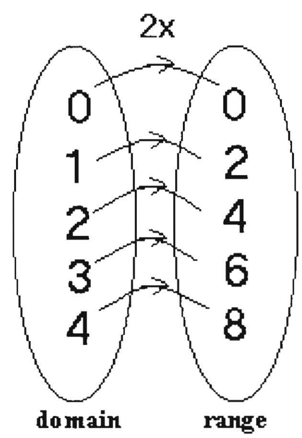
if $x = 3$ and $f(x) = x^2 + 3$

then $f(3) = (3)^2 + 3 = 12$

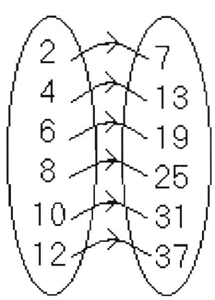


An **ordered pair** is the combination of the domain and range values that satisfy the given function.



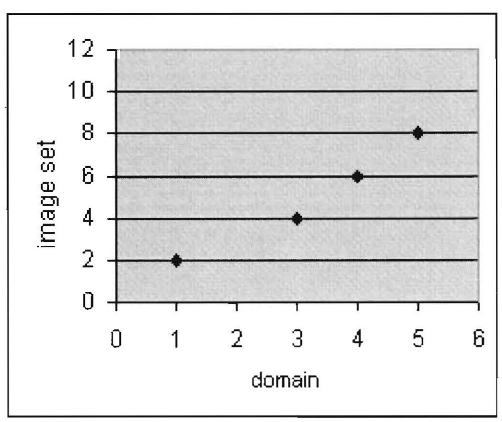


Making an ordered pair using a mapping diagram or graph is very straightforward. In order to make an ordered pair, simply link each number in the domain with its counterpart in the co-domain. Look at the following example:



The ordered pair in this mapping diagram is (2,7), (4,13), (6,19), (8,25), (10,31), (12,37).

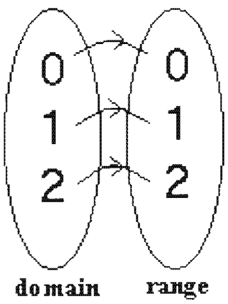
The ordered pair shown in this graph is (1,2), (3,4), (4,6), (5,8).



Just like with mapping, there is special notation used to describe a set. If we have the map of x → 2x, the function notation would be f: x → 2x or more simply f (x) = 2x..

3.1. Identity function

You have an **identity function** when every element of the domain maps onto itself. Therefore it is a *linear function*, with a *gradient* equal to one. Do you understand why?

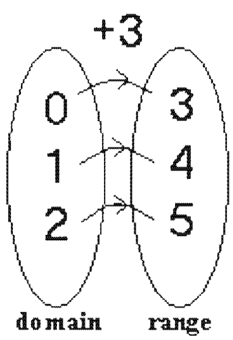


Can you see that the *map* of this *mapping diagram* is *x*→*x*?

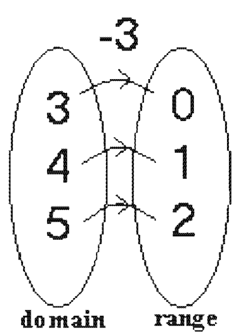
Because the map is *x* → *x*, the function is written as *f*(*x*)=x.

3.2. Inverse function

An **inverse function** is a function that follows the opposite order of operations as the original function.



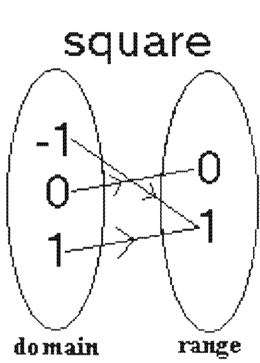
original function



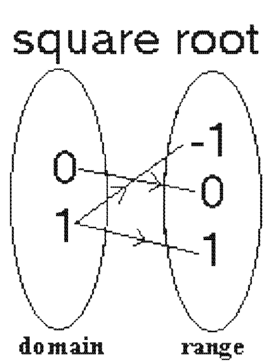
inverse function

Note only functions that are 1-1 mapping can have inverses that are also functions. Look at the example below.

Remember that in order for a map to be a function, it must have only one arrow coming from it.



original function

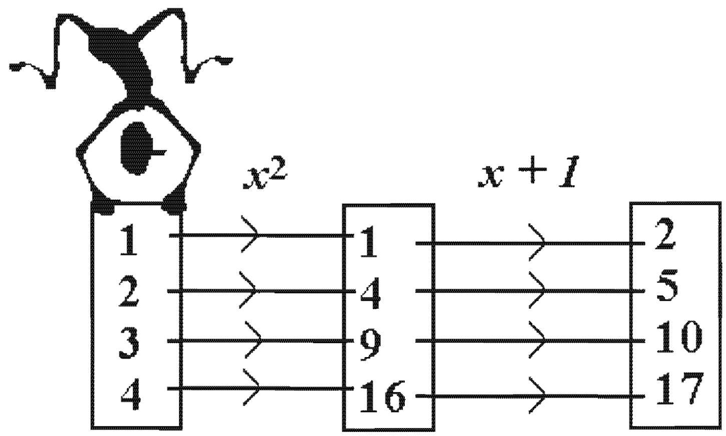


inverse function

When you are trying to find the inverse function, you must reverse the order of operations. Try to find the inverse function of $f(x) = 2x + 2$.

Function $\qquad x \to \boxed{\times 2} \to \boxed{+2} = 2x+2$

Inverse Function $\qquad \frac{(x-2)}{2} = \boxed{\div 2} \leftarrow \boxed{-2} \leftarrow x$



3.3. Composite functions

Composite functions are developed when you follow a sequence of functions. For example…

With this example $x \to x^2+1$
is the **composite function**.

When we combine two functions, f and g, the single function which maps the first set onto the last is called the **composition of f and g**.

Take a look at this…

$f(x) = 2x$
$g(x) = x + 1$

- Do you see why $g(f(x)) = 2x + 1$? Try to solve for $f(g(x))$.

It is important to recognize the order of the letters. The function gf means f is a function of g. The function fg means g is a function of f.

$$f(x) = 2x$$
$$g(x) = x+1$$
$$f(g(x)) = 2 \times (x+1)$$
$$= 2x+2$$

3.4. Inverse of a composite function

You have already learned how to find the inverse of a function. Finding the inverse of a composite function is just as simple. Try it for yourself.

$$g(f(x)) = 3x - 3$$

$$x \rightarrow \boxed{\times 3} \xrightarrow{3x} \boxed{-3} = 3x - 3$$

$$\frac{(x+3)}{3} = \boxed{\div 3} \xleftarrow{x+3} \boxed{+3} \leftarrow x$$

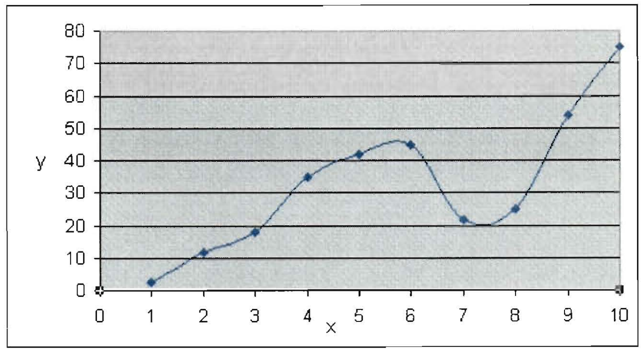
For the example above, the inverse is: $\frac{(x+3)}{3}$ The notation for an inverse function is $g(f(x))^{-1}$.

A graph is a visual representation of a function, most often used versus time. Graphs are helpful in showing trends, or helping to predict what will happen to a function.

4.1. Reading and Obtaining Information from Graphs

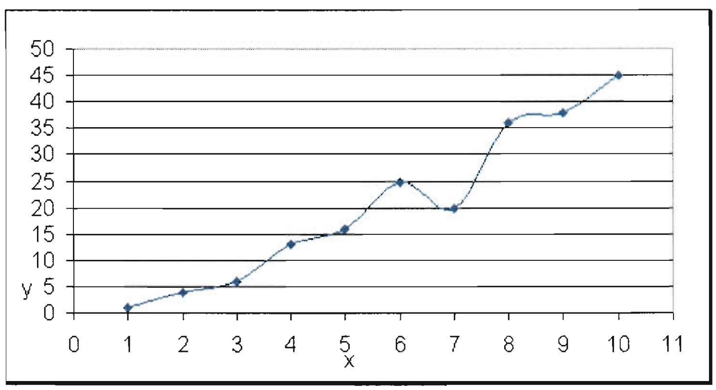
It is an important skill to be able to read and obtain information from graphs.

For example, there are a number of things that this graph shows you:



- When $x = 2$, y=12 (approx.)
- When $x = 6$, y=45 (approx.)
- The first major dip in the function occurs between x=6 and x=7.
- The largest rise in the function occurs between x=8 and x=9.
- The highest y value shown on the graph is 75.
- The graph shows that the function will most likely continue to rise.

Try this...



a) When the value of x is 6, what is the corresponding value of y?
b) Between which two points of x is the first dip in the graph seen?
c) Between which two points of x is the largest rise in the graph seen?
d) What is the largest value of y shown on the graph?
e) Between which values of x are the smallest rises in the graph seen?
f) For which values of x does the graph appear to be linear?
g) Based on the value of y from x=1 to x=10, do you predict the value of y will continue to increase or decrease? Why?

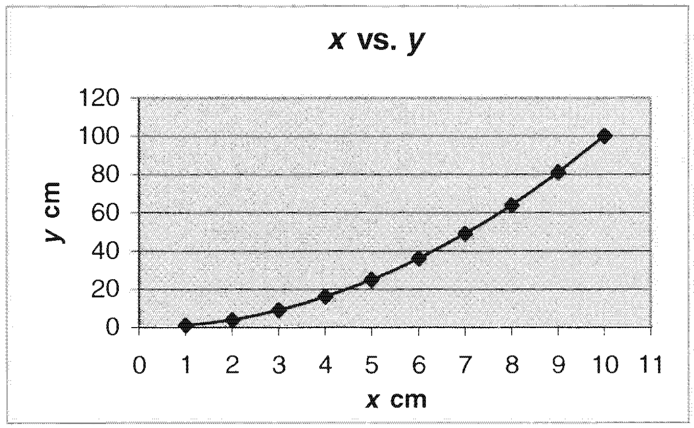
4.2. Plotting graphs from a table of information

Given a table of information, a suitable scale is needed to graph the values. The scale for the graph is determined by the minimum and maximum values of the variables in the table being graphed. After the range for the scale has been obtained, it is necessary to choose intervals such that the individual points are well spaced.

With data like the set below, the minimum value for both x and y is 1 and the maximum for x is 10 while the maximum for y is 100. Taking this into account, the scale can be 1cm to 10 cm for x and 1cm to 100 cm for y. The intervals for each of the axes is chosen so that the graph is not out of proportion with respect to the amount of space available to draw the graph and also each of the points on the graph should be distinct.

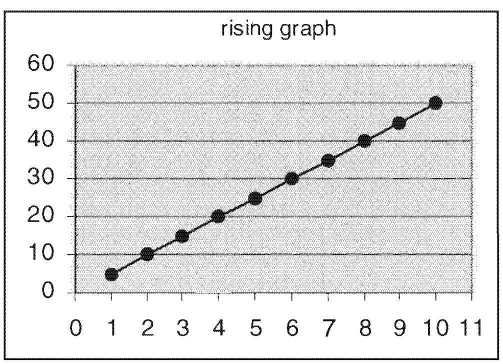
For the first example below, intervals of 1 unit seem appropriate for the x values because the points are separated by one unit and also the range of values is narrow. For the y values however, with a range of 1 to 100 one-unit intervals is not appropriate. Intervals of 10 or 20 units are more appropriate.

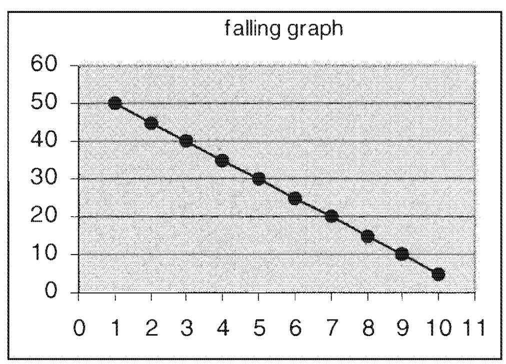
X cm	Y cm
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100



4.3. Linear graphs

A linear graph is a graph that rises or falls at a constant rate. Look at the following examples:





4.3.1. Finding the gradient or slope

The gradient or slope is defined as the rate by which a function or graph increases or decreases. The gradient can also be defined as the rise over run. That is the vertical change in the graph over the horizontal change.

$$\frac{\text{Increase in } y}{\text{Corresponding increase in } x}$$

To calculate the gradient from a linear graph, take any two points on the graph and subtract the first y value from the second y value and divide that by the first x value.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - y_1} = \text{gradient}$$

subtracted from the second x value.

Example:
Find the slope between the two points (1,4) and (5,12).

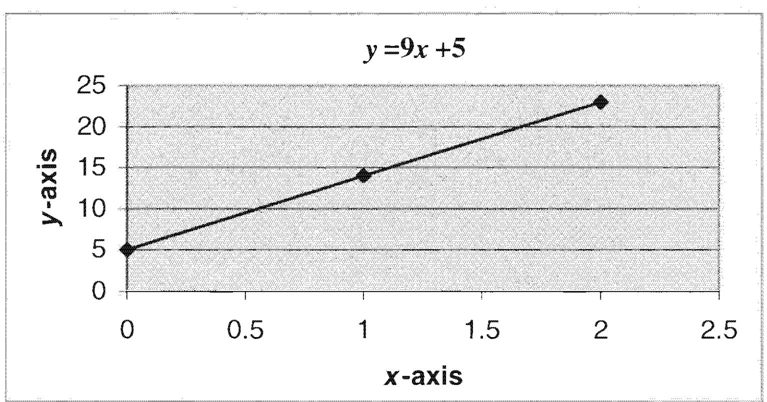
Solution:

$$Slope = \frac{12-4}{5-1} = 2$$

4.3.2. Determining the y-intercept

The y-intercept is the point where the function or graph crosses the y-axis. The y-intercept is the variable 'c' in the equation for a line y = mx+c.

Example:
Find the y-intercept for the function $y = 9x+5$.



Solution:
Looking at the equation you can see that the value for the variable 'c', the y-intercept, in the equation y=mx+c is 5. This can also be verified by looking at the graph of the function above. Observe that at x=0 the function crosses the y-axis at a value of 5.

4.3.3. Determining the x-intercept

The x–intercept is the point where the function or graph crosses the x-axis. To find the x-intercept set y=0 in the equation for a line y=mx+c and solve for x.

Finding the equation of a line using two-points

A line can be determined with two points. To solve for the equation of a line using two points, start by finding their slope. Next substitute the slope value in for the variable 'm' in the equation y=mx+c. Then substitute the x and y coordinates of one of the two points in for the x and y variables of the same equation. You will notice that the only unknown value is 'c', the y-intercept. Now solve for 'c' using the derived equation c=y-mx. Lastly, rewrite the equation y=mx+c substituting in the slope 'm' and the y-intercept 'c'

Example:
Find the equation for a line passing through the points (0,1) and (4,13).

Solution:

Step One:
Find the slope of the line between the two points.

$$(X_1, Y_1) = (0,1) \quad (X_2, Y_2) = (4,13)$$

$$Slope = \frac{(Y_2 - Y_1)}{(X_2 - X_1)} = \frac{(13-1)}{(4-0)} = 3$$

Step Two:
Substitute the slope 'm' in the equation y=mx+c.

$$y = 3x + c$$

Step Three:
Substitute one of the sets of points into the equation y=mx+c.

$$13 = 3(4) + c \quad \text{or} \quad 1 = 3(0) + c$$

Step Four:
Solve for 'c', the y-intercept.

$$c = y - mx$$

$$c = 1 - 3(0) = 1 \quad \text{or} \quad c = 13 - 3(4) = 1$$

Step Five:
Substitute in 'c', the y-intercept and 'm', the slope, into the line equation y=mx+c.

$$y = 3x + 1$$

4.3.4. Determining if lines are parallel

Parallel lines are lines that move in the same direction but never meet. That means the two lines have the same gradient or slope.

Example:
Can you figure out which functions are parallel to the function y=3x+1?

$y = 3x + 2$ • This function is parallel due to the fact that the gradients are the same.

$y = -3x + 2$ • This function is not parallel because the gradients are not equal. If you look closely, you will notice that the sign of the gradients is opposite.

$y = 4x + 2$ • This function is not parallel since the gradients are not equal.

$y = 3x + 1$ • This function is not equal because they are coincident, meaning it is the same line.

4.3.5. Determining if lines are perpendicular

Perpendicular lines are lines that intercept each other forming right angles. To determine if two lines are perpendicular, multiply their gradients together. A result of negative one means they are perpendicular. This result shows that their slopes are negative reciprocals of each other.

Example:
Which function is perpendicular to the function y=3x+1?

1. $y = 3x + 2$
2. $y = -3x + 2$
3. $y = 4x + 2$
4. $y = \frac{-1}{3}x + 2$

Solution:

To answer this question you need to solve for the slope of the function that would be perpendicular to the given function. Remember that the slope of the perpendicular function is the negative reciprocal of the slope of the given function. So the slope of the perpendicular function would be (-1/3). Thus any function with this slope would be a solution to this example. Looking at the available choices it is evident that choice number four is the correct answer.

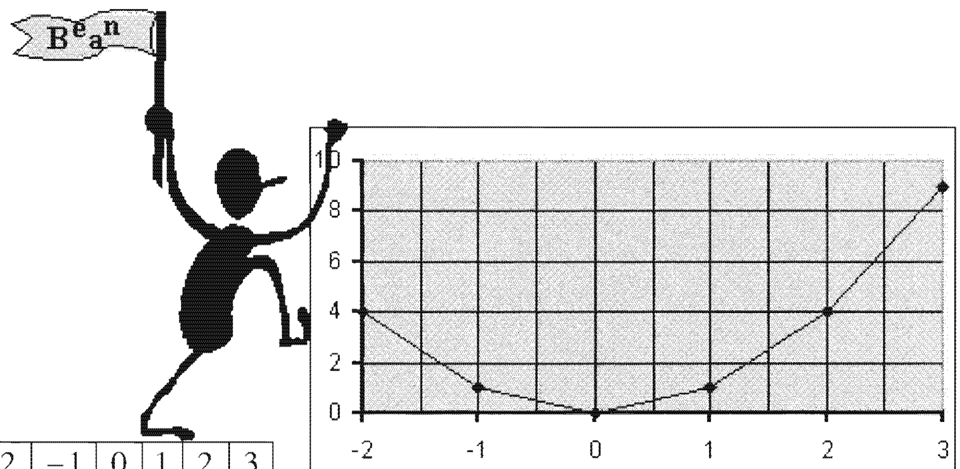
Remember when calculating the negative reciprocal you can use the formula (m x n = -1). The 'm' is the slope of the given function and n is the slope of the unknown function. Thus when solving for n you get the equation below.

$$n = \frac{-1}{m}$$

4.4. Quadratic graphs

A **quadratic graph** is a "U-shaped" curve. A *positive* x^2 term is $\cup$-shaped, a *negative* x^2 term is $\cap$-shaped.

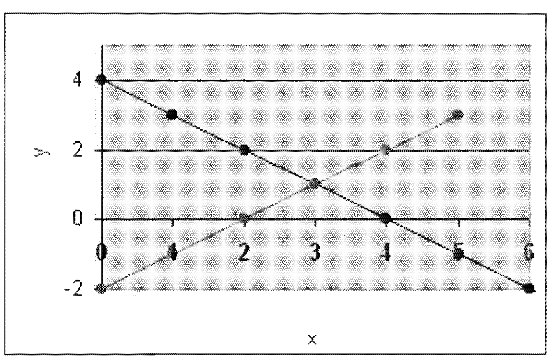
Can you plot the following points and connect them to draw a quadratic curve?



x	-2	-1	0	1	2	3
y	4	1	0	1	4	9

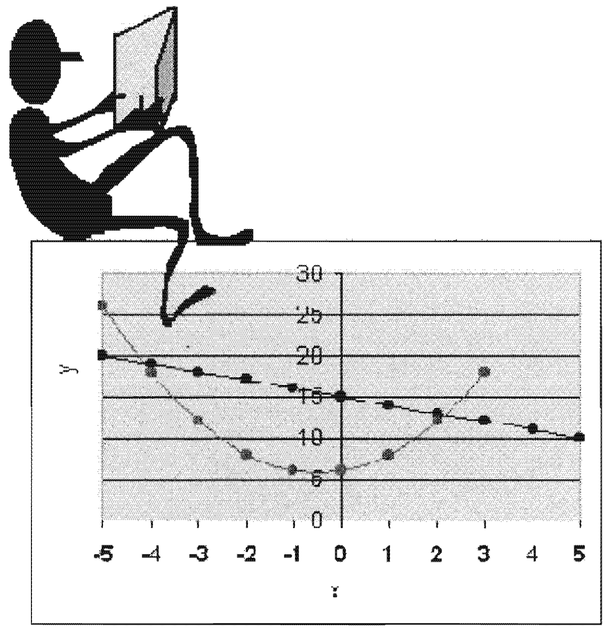
4.5. Simultaneous equations

Multiple equations can be solved simultaneously by using a graph. The solution to a pair of equations can be found by plotting the two functions on the same graph and by determining their intersection point. Look at the following example with two linear lines:



The equations plotted are $x+y=4$ and $x-y = 2$. The line with the point (0,4) provides all of the solutions to $x+y = 4$. The line with the point (0, -2) provides all of the solutions to $x-y = 2$. The points that lie on both lines are solutions to both equations. The only point that lies on both of these lines is (3,1). Therefore the solution to both equations is $x=3$, $y=1$.

Equations that result in a graph of one linear and one quadratic equation can also be solved simultaneously. Look at the following example:



Plotted are the graphs $x+y=15$ and x^2+x+6. Again, the points that lie on both lines are solutions to both equations. In this case, there are two points that lie on both lines. These points are (-4,19), and (2,13). Therefore, there are two solutions to these equations. One solution is $x= -4$, $y=19$. The other solution is $x=2$, $y=13$.

4.6. Direct variation

Direct variation is when an increase in one object causes a proportional increase in another object or a decrease in one causes a proportional decrease in the other. For example, $y \propto x$ means y varies directly with x. The extent or factor by which this direct variation occurs is called the constant of variation and is denoted as k. Hence the preceding example can be written as $y = kx$, and $k = y/x$.

Example:

Using $y = kx$

If y = 4 when x = 8, what is y equal to when x = 10?

1) Plug in the given set of values for x and y. — $4 = k(8)$
2) Solve for the constant of variaton (k). — $k = (4/8) = (1/2)$
3) Using the constant of variation, you can solve for y using the other given value of x.

$y = kx$
$y = (1/2)(10)$
$y = 5$

4.7. Inverse variation

Inverse or indirect variation is when a change in one object causes an opposite effect on the other object. If an increase in one object causes a decrease in the other, or a decrease in one causes an increase in the other, then the relationship between those two objects is said to be inverse variation. This is denoted as $y \propto 1/x$ and is read as "y is inversely proportional to x" This can also be written as $y = k/x$, where k is the constant of variation. To calculate k, make k the subject of the equation. (i.e. $k = yx$.)

Example:

Using $y = \dfrac{k}{x}$:

If y = 12 when x = 2, what is y equal to when x = 4?

1) Plug in the given set of values for x and y.
2) Solve for the constant of variaton (k).
3) Using the constant of variation, you can solve for y using the other given value of x.

$$12 = \frac{k}{2}$$

$$k = 12*2$$

$$k = 24$$

$$y = \frac{24}{4}$$

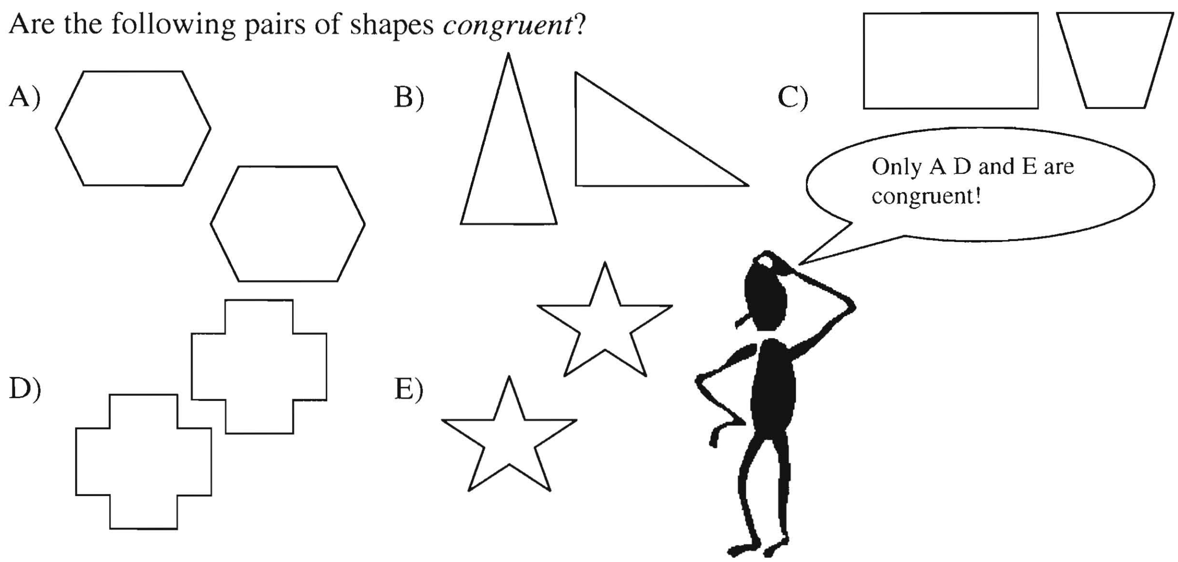
$$y = 6$$

Geometry is the study of shapes, figures, and areas. This important topic in mathematics is unlike any other topic you have covered or will cover. Geometry does not depend so much on numbers; its main focus is on the relationship between objects.

5.1. Congruency

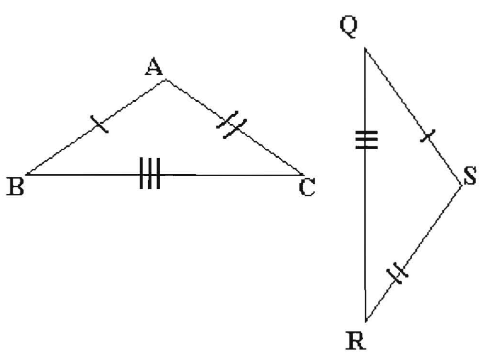
Shapes that are equal in all respects, (including shape, size of angles, and length of sides) are **congruent**.

Are the following pairs of shapes *congruent*?



5.1.1. Congruent triangles

Here, we see some common notations used to show congruency between sides. The ticks tell us which sides are equal in length. Therefore AB = SQ, AC = SR, and BC = QR. With this knowledge, we can say that triangle ABC is congruent to triangle SQR, or $\Delta ABC \equiv \Delta SQR$. The $\equiv$ sign means "*congruent to*". If you trace triangle ABC and fit it onto triangle SQR, you'll find angle A fits onto angle S, B onto Q, and C onto R. We say $\angle A$ **maps** onto $\angle S$ or $\angle A \rightarrow \angle S$. Complete the mapping:

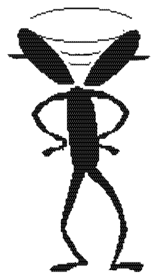


$\angle B \rightarrow$

$\angle C \rightarrow$

It is important to realize that the order of the letters in the congruency statement are significant. For example, if we know ΔDEF ≡ ΔPUY, then we know the following six things:

ΔD → ΔP
ΔE → ΔU
ΔF → ΔY

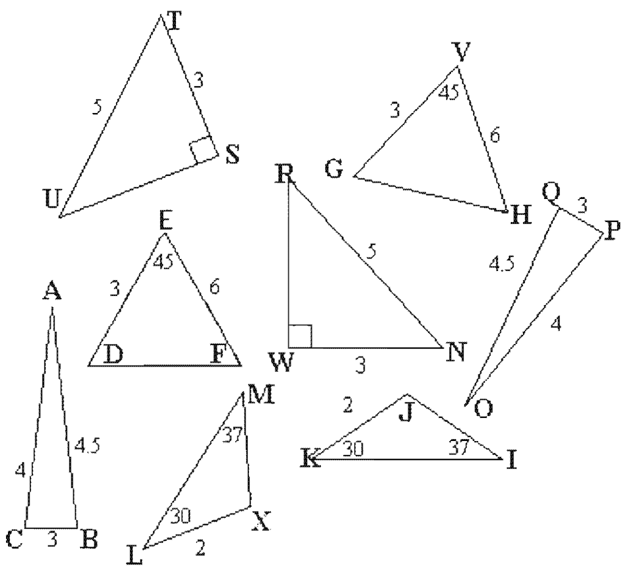


DE = PU
DF = PY
EF = UY

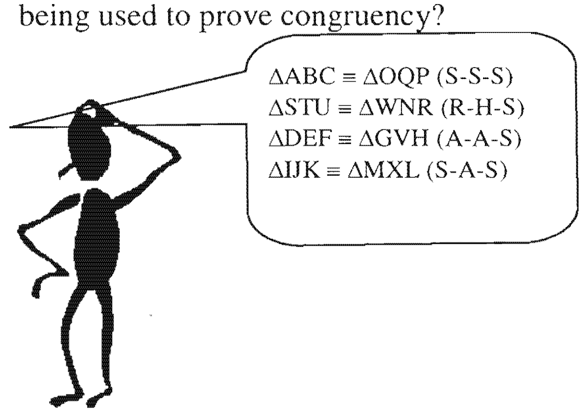
5.1.2. Congruency postulates

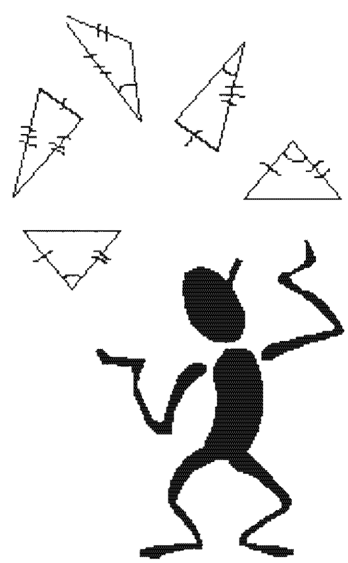
Two triangles are congruent if:

1) three sides of one triangle equal three sides of the other (S-S-S)
2) two sides and the included angle of teach are equal (S-A-S)
3) two angles and a corresponding side of each are equal (A-A-S)
4) both have a right angle, and the hypotenuse and a corresponding side of each are equal (R-H-S)



Which pairs of triangles on the left are congruent, and which postulate is being used to prove congruency?



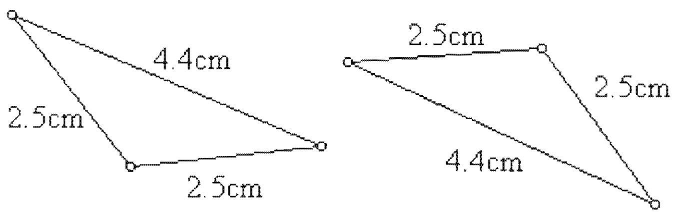


Which of the triangles that Mr. Bean is juggling are congruent, and why?

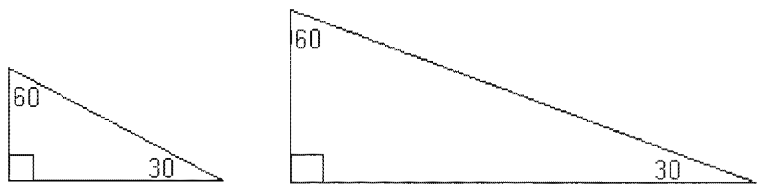
5.2. Similarity

Similarity is when two triangles either have three sides in common, three sides proportionally alike, or three angles in common.

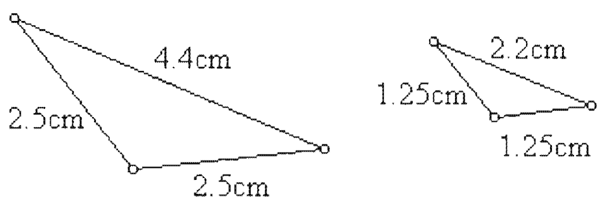
Take a look at the following examples:



These two triangles are similar because they have similar sides.



These two triangles are similar because they have similar angles.



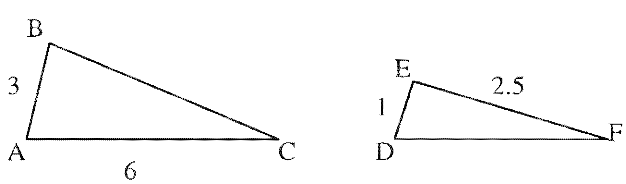
These two triangles are similar because their sides are equal in proportion. For example:
$1.25 \times 2 = 2.50$
$2.20 \times 2 = 4.40$

5.2.1 Finding missing edges in similar triangles

Similar triangles are useful for a number of reasons. One of the reasons that similar triangles are helpful is because you can find unknown sides on one if you know enough information about one similar to it.

In order to determine missing sides in triangles, simply set up ratios.

Example:



Given that triangles ABC and DEF are similar, you know that lengths AB and DE are proportional. Therefore, the ratio between the two triangles is AB:DE or 3:1. All of the lengths of triangle ABC will be 1/3 the size of their corresponding side on triangle DEF.

$$\frac{AB}{DE} = \frac{BC}{EF} \qquad \frac{3}{1} = \frac{BC}{2.5}$$

Therefore, BC=7.

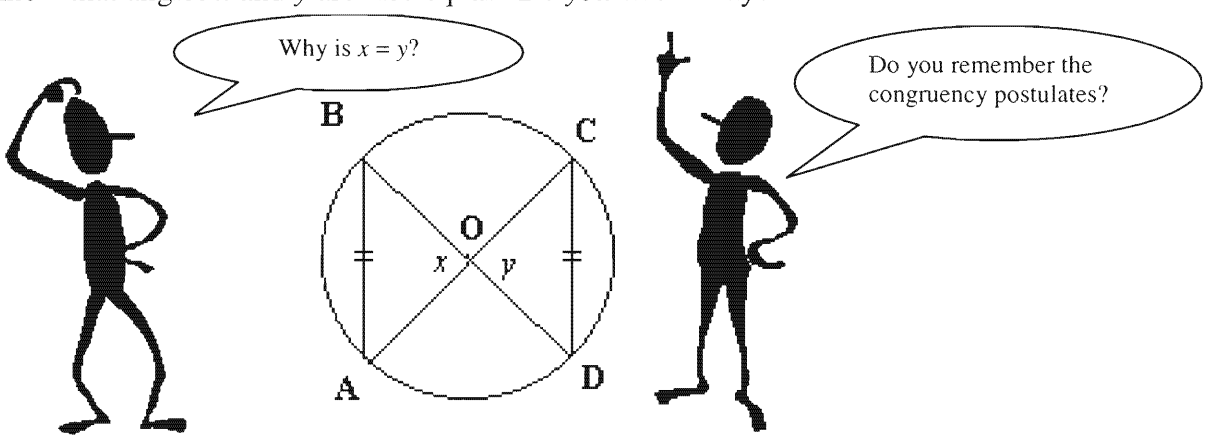
Using a proportion, you can also determine DF.

$$\frac{AB}{DE} = \frac{AC}{DF} \qquad \frac{3}{1} = \frac{6}{DF}$$

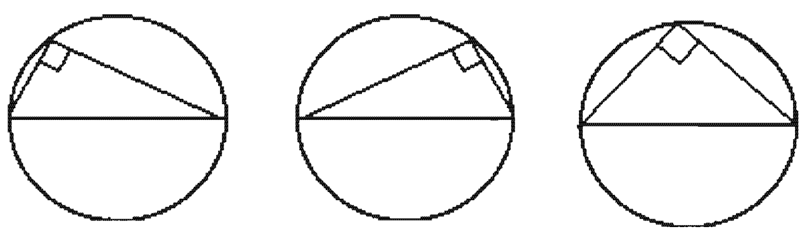
Therefore, DF=2.

5.3. Angles and Circles

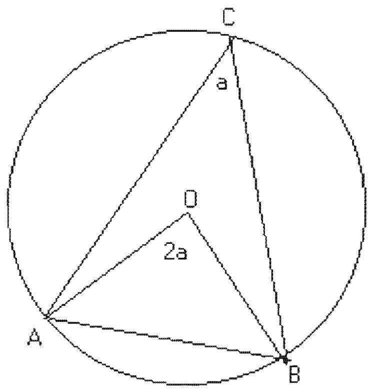
In the example below, if we know that chords AB and CD are equal in length, then we know that angles *x* and *y* are also equal. Do *you* know why?



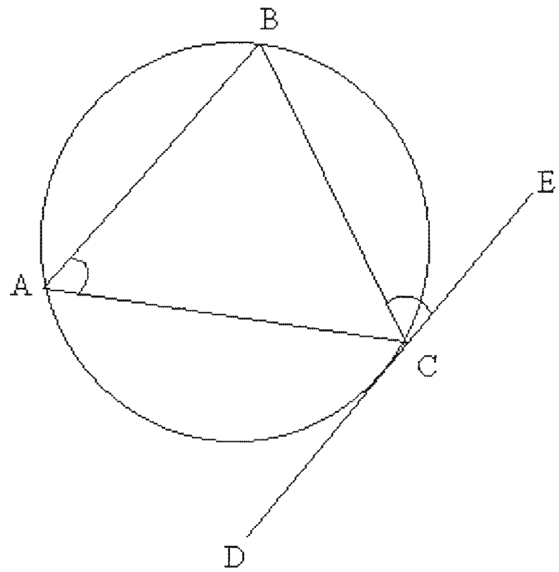
In the next example, we can see an angle in a *semi-circle* is always 90 degrees, regardless where the two chords join.



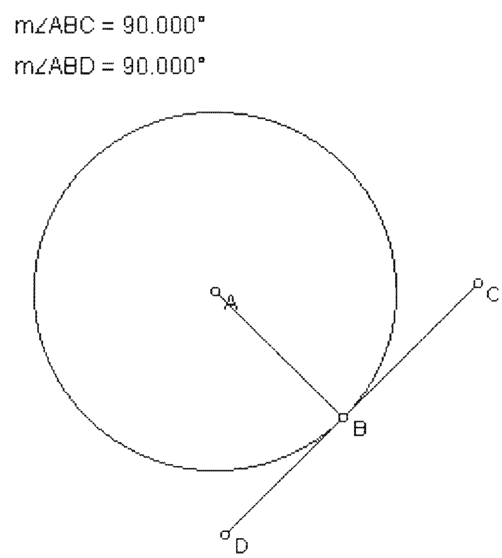
There are other special features with angles in circles. Say you have a circle with a chord 'AB' and a center 'O'. The angle formed at the center of the circle, AOB, is twice as much as angle ACB. Angle AOB is formed by connecting the end points 'A' and 'B' of the chord to the center of the circle. Angle ACB is formed by connecting the end points of the chord to a point 'C' that is on the other side of chord 'AB'. If point 'C' is not on the other side of the chord, this idea will not prove correct.



Given a circle with a chord, the angle formed between the chord and a tangent drawn to the circle form an angle equal to the angle located on the circumference of the circle joining the endpoints of the chord.

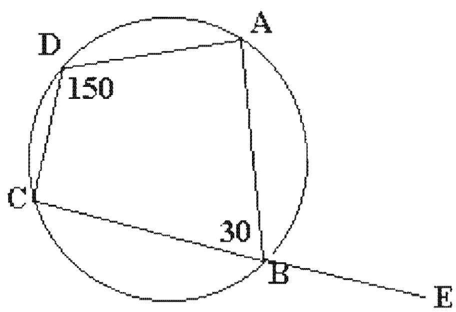


A tangent is a line that is perpendicular to another line. The importance of a tangent line now is that we will consider one with respect to the radius of a circle. The angle between a tangent line and a radius is always 90°.



5.3.1. Cyclic Quadrilaterals

A cyclic quadrilateral is a quadrilateral that is drawn in such a way that the corners of the quadrilateral are on the circumference of the circle. In a cyclic quadrilateral the sum of opposite angles is 180°. Consider the figure below and develop the relationship between the exterior angle and the opposite interior angle.



Since ∆CDA and ∆ABD are opposite angles in a cyclic quadrilateral they add up to 180°. CBE is a straight line so it means that the ∆ABC and ∆ABE should add up to 180°. We know that ∆ABC is 30°. That means ∆ABE = 180°-30° =150°. This means that ∆ADC = ∆ABE. This rule can be stated as "an exterior angle and its opposite interior angle in a cyclic quadrilateral are equal."

Glossary

Chord	Line joining two points on the circumference of a circle.
Circumference	Distance around a circle. Also known as the perimeter.
Co-domain	Output values of a number machine.
Composite functions	Combination of two functions used to create a new function.
Composition	Combination of two or more functions.
Congruency	Shapes that are exactly alike in all respects, including size, shape, and angle size.
Congruency statement	A statement used to note when two triangles are congruent.
Constant function	A function where element of the domain maps onto the same image.
Cyclic quadrilateral	A quadrilateral with endpoints that are on the circumference of a circle.
Decimal	Any fraction with a denominator of any power of 10.
Decimal fractions	See decimal.
Diameter	Any line that joins two points on a circle and passes through the center.
Domain	The input values of a number machine.
Error	The difference between the observed or recorded result and the correct one.
Exponent	See index.
Fraction	A number less than one.
Function	A special kind of relation in which each object is mapped onto only one image.
Gradient	The rate in which a relation or function increase or decreases.

Graph (linear)	A plot that rises or falls at a constant rate.
Graph (quadratic)	A graph that follows the relation of a constant by a term x2
Image set	The term used to describe when every element of the domain maps onto itself.
Index	See range.
Intercept (x)	Point where a graph intersects the x-axis.
Intercept (y)	Point where a graph intersects the y-axis.
Irrational number	A number that cannot be written as a fraction due to recurring decimals.
Lowest common denominator (LCD)	See common fractions.
Mapping	A relation in which for each object mapped there is only one image.
Ordered pair	a visual aid that represents a number machine.
Permutation	"The combination of domain and range in the form (domain, range)."
Radius	Distance from the center of a circle to any point on the circumference.
Range	The set of numbers onto which the domain is mapped. Also known as the image set.
Rational numbers	The y values of a function or the co-domain of a 1-1 or many to 1 mapping.
Recurring decimal	"A decimal that has one digit, or a group of digits, that is repeated endlessly."
Rounding off	A way of writing the number with fewer non-zero digits.
Self-inverse function	"If an element has an inverse under an operation, then the function is self-inverse."
Semi-circle	Half a circle. It is a shape formed by a diameter and an arc of a circle joining its endpoints.

Significant figures	The first figure digit (not zero) that you reach reading from left to right.
Similarity	Shapes that are alike through equal angles or sides or proportional in size.
Simultaneous equations	Two or more equations that have one or more solutions in common.
Standard form	A number that is written as a number between 1 and 10 and multiplied by a power of 10.

A fresh look at...
FORM 4 MATHEMATICS
for the
British Virgin Islands High School

WORKBOOK

by Edith Ampadu, Bill Burgess,
Jason Cobb, and Aaron Lopez.

1. COMPUTATION AND NUMBERS

1) Addition

(a) $\frac{4}{5}+\frac{2}{3}=$ (c) $\frac{1}{9}+\frac{1}{7}=$ (e) $\frac{3}{6}+\frac{2}{8}=$

(b) $\frac{9}{12}+\frac{4}{24}=$ (d) $\frac{4}{6}+\frac{1}{5}=$ (f) $\frac{3}{6}+\frac{5}{3}=$

2) Subtraction

a) $\frac{15}{16}-\frac{7}{8}=$ g) $\frac{5}{8}-\frac{1}{4}=$ m) $3-\frac{9}{2}=$

b) $\frac{3}{2}-\frac{4}{4}=$ h) $\frac{5}{4}-\frac{7}{4}=$ n) $\frac{14}{5}-\frac{11}{2}=$

c) $\frac{9}{6}-\frac{17}{12}=$ i) $\frac{3}{16}-\frac{7}{8}=$ o) $\frac{21}{5}-\frac{11}{2}=$

d) $\frac{5}{4}-\frac{2}{3}=$ j) $\frac{5}{32}-\frac{2}{16}$ p) $\frac{4}{9}-\frac{3}{7}=$

e) $\frac{8}{7}-\frac{2}{21}=$ k) $\frac{7}{3}-\frac{1}{5}=$ q) $\frac{6}{10}-\frac{4}{8}=$

f) $\frac{1}{2}-3=$ l) $\frac{17}{9}-\frac{7}{5}=$ r) $\frac{14}{8}-\frac{6}{2}=$

3) Multiplication

(a) $\frac{1}{2}\times\frac{5}{9}=$ (c) $\frac{6}{7}\times\frac{8}{9}=$ (e) $\frac{6}{2}\times 3=$ (g) $\frac{1}{2}\times\frac{3}{4}=$ (i) $\frac{3}{7}\times\frac{4}{5}=$

(b) $\frac{8}{5}\times\frac{7}{8}=$ (d) $\frac{2}{3}\times 2\frac{7}{9}=$ (f) $\frac{6}{2}\times 3=$ (h) $\frac{1}{2}\times\frac{9}{10}=$ (j) $\frac{7}{5}\times\frac{8}{9}=$

4) Division

a) $\frac{1}{9} \div \frac{2}{3} =$	b) $\frac{3}{2} \div \frac{4}{4} \div \frac{17}{9} =$	c) $\frac{3}{2} \div \frac{1}{4} =$	d) $\frac{7}{9} \div \frac{1}{5} =$
e) $\frac{5}{9} \div \frac{3}{5} =$	f) $\frac{1}{2} \div 3 =$	g) $\frac{1}{2} \div 7 =$	h) $3 \div \frac{6}{2} =$
i) $\frac{3}{2} \div \frac{4}{4} =$	j) $\frac{17}{9} \div \frac{9}{15} =$	k) $\frac{7}{8} \div \frac{8}{5} =$	l) $\frac{17}{9} \div \frac{7}{5} =$
m) $3 \div \frac{1}{2} =$	n) $\frac{1}{2} \div \frac{23}{9} =$	o) $\frac{3}{9} \div \frac{12}{2} =$	p) $\frac{2}{3} \div \frac{17}{34} =$
q) $\frac{3}{9} \div \frac{9}{15} =$	r) $\frac{9}{8} \div \frac{8}{9} =$	s) $\frac{1}{9} \div \frac{6}{6} =$	t) $\frac{19}{3} \div \frac{19}{3} =$

5) Addition

(a) 0.6584 + 52.4196=
(b) 58.5486 + 6.414=
(c) 34.54 + 581=
(d) 0.0056+0.1241=
(e) 798.4+0.685=
(f) 0.65488+56.55879=
(g) 687.6581+7.8952=
(h) 964.921+0.0452=
(i) 8.695+46.5960=
(j) 70.0108+64.5493=

6) Subtraction

a) 0.919-0.448=
b) 0.502-0.345=
c) 0.843-0.187=
d) 0.211-0.199=
e) 0.973-0.551=
f) 1.874-0.886=
g) 0.633-0.213=
h) 0.668-0.487=
i) 2.785-0.382=
j) 1.027-0.781=
k) 3.497-0.499=
l) 2.64-1.451=
m) 0.197-0.427=
n) 8.455-3.678=

7) Multiplication

a) 0.5 × 7.0=
b) 0.20 × 5 08=
c) 2.5 × 25=
d) 1.06 × 10.10=
e) 6.4 × 0.04=
f) 0.008 × 8=
g) 3 × 0.008=
h) 7.12 × 0.003=
i) 8.823 × 0.1=
j) 0.025 × 0.05=

8) Division

a) 1.2÷4=
b) 1.2÷0.4=
c) 1.6÷2.4=
d) 1.6÷0.0004
e) 6.3÷0.7=
f) 9.9÷3.3=
g) 0.56÷0.08=
h) 8.1÷0.9=
i) 7.6÷0.3=
j) 3.3÷9.9=
k) 1.2÷0.44=
l) 1.28÷0.4=
m) 16÷0.24=
n) 186÷0.4=
o) 6.37÷0.07=
p) 8.9÷4.45=
q) 0.56÷0.07=
r) 8.19÷0.9=
s) 7.8÷0.35=
t) 3.6945÷0.09=

9) Convert the following fractions to decimals.

(a) 6/3
(b) 5/8
(c) 8/13
(d) 6/17
(e) 3/9
(f) 4/5
(g) 2/5
(h) 3/4
(i) 7/10

10) Convert the following decimals to fractions.

(a) 0.23=
(b) 0.47=
(c) 0.95=
(d) 0.438=
(e) 0.017=
(f) 0.500=
(g) 0.846=
(h) 0.112=
(i) 1.437=
(j) 2.344=

Rounding off numbers

11) Change each of the following to 3 decimal places

(a) 0.65488
(b) 56.55879
(c) 687.6581
(d) 7.8952
(e) 9.999

12) Write each of the following to 4 decimal places

(a) 65.15834
(b) 123.6857
(c) 964.0009
(d) 0.00045682
(e) 8.695
(f) 46.5960
(g) 70.0108
(h) 4.4444
(i) 0.01068
(j) 64.549343

13) How many decimal places are the following written to?

(a) 6.4664
(b) 8.89
(c) 16.46396
(d) 4.436
(e) 0.1005
(f) 8.9731
(g) 806.16
(h) 0.00064
(i) 83.1
(j) 9846

14) Write each of the following to 3 significant figures

(a) 0.00568
(b) 78.925
(c) 7.4519889
(d) 68.19
(e) 50.159

15) Write the following to 6 significant figures

(a) 65.15834
(b) 1283.657
(c) 964.009
(d) 0.00045682
(e) 8.695

16) Write the following to four significant figures

(a) 65.15834
(b) 1283.657
(c) 964.009
(d) 0.00045682
(e) 8.695

17) To what significant number has the following been written?

(a) 543.54
(b) 468.5
(c) 0.10056
(d) 14.5668
(e) 0.00056

19) Write each number in standard from.

(a) 1000	(c) 278.2	(e) 12.34	(g) 0.034	(i) 56.73
(b) 1100	(d) 0.345	(f) 577.8	(h) 7.724	(j) 0.002

20) Write each number in full.

(a) 1.0×10^{3}	(c) 1.77×10^{4}	(e) 5.7×10^{1}	(g) 2.1×10^{-3}	(i) 6.67×10^{-1}
(b) 4.27×10^{-2}	(d) 3.9×10^{-6}	(f) 1.8×10^{5}	(h) 1.23×10^{5}	(j) 3.12×10^{4}

21) Round the following to one (1) decimal place, identify the amount of error, then identify the greatest possible error.

(a) 1.25	(g) 9.49	(m) 39.85	(s) 76.94	(y) 59.32
(b) 6.52	(h) 13.45	(n) 14.18	(t) 47.08	(z) 4.979
(c) 3.67	(i) 12.26	(o) 8.41	(u) 19.158	(aa) 53.665
(d) 5.43	(j) 15.43	(p) 64.145	(v) 20.43	(bb) 23.439
(e) 4.90	(k) 3.29	(q) 86.43	(w) 71.97	(cc) 75.614
(f) 13.54	(l) 5.38	(r) 14.83	(x) 82.470	(dd) 7.30

22) Round the following to two (2) decimal place, identify the amount of error, then identify the greatest possible error.

(a) 11.326	(g) 43.689	(m) 5.115	(s) 69.512	(y) 79.438
(b) 16.011	(h) 12.345	(n) 70.162	(t) 26.248	(z) 6.489
(c) 1.123	(i) 24.015	(o) 86.238	(u) 29.412	(aa) 15.517
(d) 21.653	(j) 69.113	(p) 36.174	(v) 46.250	(bb) 63.099
(e) 55.748	(k) 42.356	(q) 7.314	(w) 38.274	(cc) 31.430
(f) 40.239	(l) 62.945	(r) 58.481	(x) 44.765	(dd) 17.432

23) Round the following to three (3) decimal place, identify the amount of error, then identify the greatest possible error.

(a) 69.1135	(g) 36.1746	(m) 12.5342	(s) 13.4394	(y) 92.47891
(b) 78.1827	(h) 94.5149	(n) 82.874	(t) 29.92145	(z) 41.48508
(c) 44.4449	(i) 82.5241	(o) 48.2819	(u) 98.21349	(aa) 27.59034
(d) 5.1152	(j) 33.5523	(p) 59.2886	(v) 88.5655	(bb) 32.94034
(e) 12.6303	(k) 111.4385	(q) 36.2805	(w) 39.54392	(cc) 14.59036
(f) 10.1572	(l) 52.2892	(r) 33.4394	(x) 54.12904	(dd) 20.15555

24) Using the information given, answer the following questions.

The heights of six students were measured and the lengths were recorded as follows: 128cm, 162cm, 186cm, 157.45cm, 147.9cm and 155cm.

(a) Which of these will you have to rewrite?
(b) Write down the greatest possible value for each of the ones you will rewrite
(c) Write down the least possible values for the height of each of the students.

The lengths of three sticks are recorded as follows: 8.4cm, 5.2cm and 9.6cm to 1 decimal place.

(d) Write down the greatest possible value for the length of each rod to 2 decimal places
(e) Write down the least possible value for each of the lengths.
(f) Write down the greatest possible value for the total length of the sticks.
(g) Write down the least possible value for the total length of the sticks.

The sides of a notebook measures 4.6cm, 7.7cm and 9.3cm.
(h) Find the area occupied by the book
(i) Find it's smallest possible area
(j) Find it's largest possible area

Base Numbers

25) Change from 10 to base 2

(a) 12	(c) 45	(e) 8725	(g) 9	(i) 111
(b) 197	(d) 7367	(f) 89	(h) 62822	(j) 43

26) Add the following.

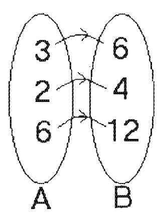
(a) 12+23=	(d) 32+22=	(g) 33+2=	(j) 33+40=
(b) 12+20=	(e) 34+42=	(h) 32+22=	
(c) 3+2=	(f) 14+42=	(i) 33+12=	

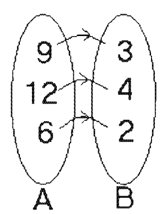
2. MAPPING

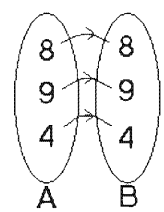
1) Draw the mapping diagram using the mapping rule and the given domains.

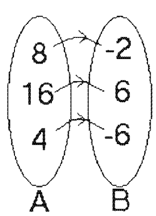
(a) $x \rightarrow 2x+4$ {1, 2, 3, 4}
(b) $x \rightarrow 3x-1$ {0, 1, 2, 3, 4, 5}
(c) $x \rightarrow 4x+2$ {-2, -1, 0, 3, 5}
(d) $x \rightarrow 4x-3$ {-3, 3, 7}
(e) $x \rightarrow 2x-5$ {0, 1, -2, 3, 4, 5}
(f) $x \rightarrow x-2x$ {9, 11, 15}
(g) $x \rightarrow x-4$ {1, 8, -7, 4}
(h) $x \rightarrow x-4x$ {-3, -2, 0, 1, 3}
(i) $x \rightarrow x+2x$ {21, 9, 14, -3, 15}
(j) $x \rightarrow x-3x$ {-12, 10, -14, 18, 21, -22}
(k) $x \rightarrow x-5x$ {1, 2, 3, 4}
(l) $x \rightarrow 5x-2$ {-2, -1, 0, 3, 5}
(m) $x \rightarrow 3x+4.5$ {-2, 8, 11, 29}
(n) $x \rightarrow 7x-3$ {-3, -2, 0, 1, 3}
(o) $x \rightarrow 4-2x$ {1, 8, -7, 4}
(p) $x \rightarrow 5+2.5x$ {21, 9, 14, -3, 15}

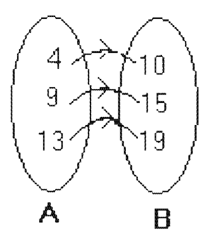
2) Determine the rule of mapping for each of the following

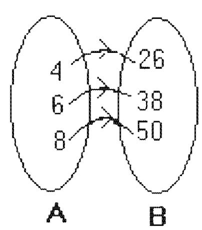
(a)


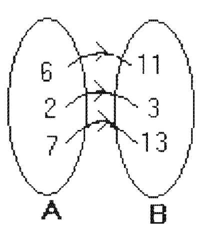
(d)


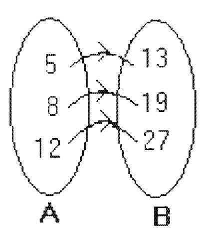
(g)


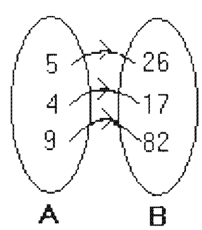
(b)


(e)


(h)


(c)


(f)


(i)


3) Using the domain below, draw a mapping diagram that shows the following relations
Domain = {2, -5, 4}

(a) $x \rightarrow x + 6$
(b) $x \rightarrow 5x$
(c) $x \rightarrow x^2 - 6$
(d) $x \rightarrow 3x + 2$
(e) $x \rightarrow 8x - 8$
(f) $x \rightarrow 7x - 8$
(g) $x \rightarrow 3+8x$
(h) $x \rightarrow 5x - 18$

3. FUNCTIONS

1) For the given functions and domains, determine the range.

(a) $f(x) = x^2 + 2$ for {1, 2, 3, 4, 5}
(b) $f(x) = -x^2 + 1$ for {0, 1, 2, 6, 7}
(c) $f(x) = x^2 + 2x + 3$ for {-1, -2, 0, 1, 2}
(d) $f(x) = x^2 + x - 5$ for {1, 2 ,3, 4}
(e) $f(x) = x - 12$ for {-6, 0, 6}
(f) $f(x) = x^3 + 2x^2 - x - 10$ for {-3, -1, 0, 1, 2}
(g) $f(x) = 3x^2 - 15$ for {-1, 0, 1}
(h) $f(x) = 2x^2 + 2$ for {-2, -1, 0, 1, 2, 3}
(i) $f(x) = 2x + 10$ for {-5, -2, 0, 2, 5}
(j) $f(x) = 4x^2 - 30$ for {-3, -2, 0, 1, 2, 3, 4, 5}

2) Given that $g(x) = x$, where $x \in$ {-3, -2, -1, 0, 1, 2, 3}

(a) Write the image set.
(b) If an image for $g(x)$ is {-6, -5, -4, 2, 6, 8}, what are the ordered pairs.
(c) Is $g(x)$ an identity function?
(d) Show the graph of $g(x)$. What do you notice?
(e) Looking at the graph, what is the y value when x = -1983.

3) Find the inverse of the functions.

(a) $f(x) = x + 4$
(b) $f(x) = 3x$
(c) $f(x) = x - 3$
(d) $f(x) = x/5$
(e) $f(x) = 7x$
(f) $f(x) = x - 8$
(g) $f(x) = 2x - 4$
(h) $f(x) = 3x + 24$
(i) $f(x) = x/5 + 15$
(j) $f(x) = 3x/4 - 12$

4) Determine the composite function $g(f(x))$, given the following functions.

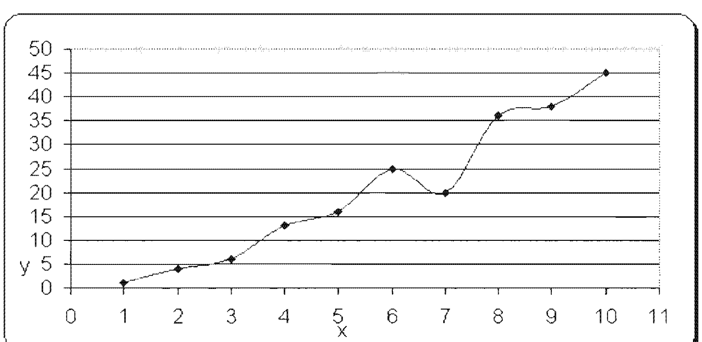
(a) $f(x) = 2x + 5$ and $g(x) = x$
(b) $f(x) = 3x - 7$ and $g(x) = x^2 + x + 2$
(c) $f(x) = 2x + 1$ and $g(x) = x - 4$
(d) $f(x) = x + 2$ and $g(x) = 2x + 10$
(e) $f(x) = 4x - 8$ and $g(x) = x + 2$
(f) $f(x) = x + 2$ and $g(x) = 3x - 6$
(g) $f(x) = x - 9$ and $g(x) = x + 1$
(h) $f(x) = 6x + 14$ and $g(x) = 6x - 5$
(i) $f(x) = x - 6$ and $g(x) = 3x + 2$
(j) $f(x) = x + 13$ and $g(x) = x/2 - 4$

5) Determine the inverse of the composite functions from previous question (question 4).

4. GRAPHS I

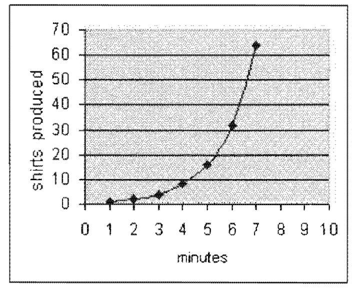
1)

(a) When the value of x is 6, what is the corresponding value of y?
(b) Between which two points of x is the first dip in the graph seen?
(c) Between which two points of x is the largest rise in the graph seen?
(d) What is the largest value of y shown on the graph?
(e) Between which values of x are the smallest rises in the graph seen?

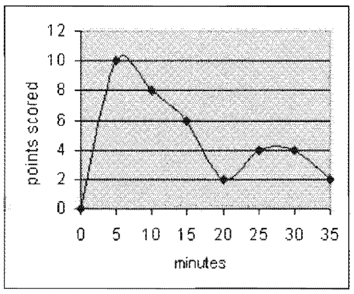


(f) For which values of x does the graph appear to be linear?
(g) Based on the value of y from x=1 to x=10, do you predict the value of y will continue to increase or decrease? Why?

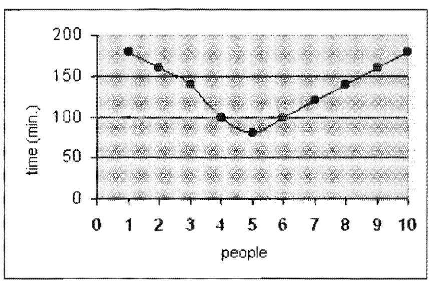
2)
The graph shows the number of shirts produced versus the number of minutes the machine is running.



(a) How many shirts are produced after 4 minutes?
(b) During what one-minute interval are the most shirts produced? How many?
(c) During what interval are the least shirts produced?
(d) Does the machine produce more or less shirts the longer it is running?

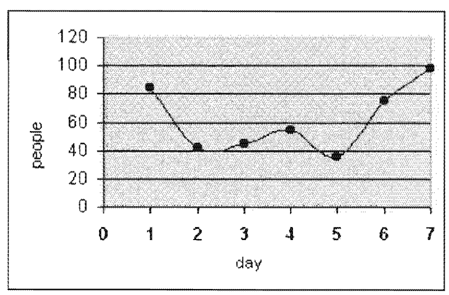


3)
The following graph shows the total number of points a basketball player scores during the first 35 minutes of the game.
(a) During what 5-minute interval are the most points scored?
(b) During what interval does the player score the least amount of points?
(c) When does the player score 8 points?
(d) Where does it appear that the player is getting tired?

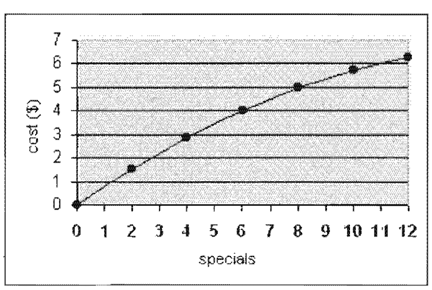


4) The following graph shows the amount of time it takes to fully clean a boat based on the number of people involved.
(a) What is the best number of people to have helping to clean the boat?
(b) Having 3 people help will take the same amount of time as having how many people helping?
(c) Approximately how long will it take to clean the boat with 6 people?

5)
The following graph shows the number of people who visit a particular beach each day of the week. (For example, 1 is Sunday, 3 is Tuesday, etc.)



(a) Which day of the week does the beach have the greatest number of visitors?
(b) Which day of the week does the beach have the fewest number of visitors?
(c) Approximately how many people visit the beach on Thursday?
(d) Approximately how many people visit the beach on Monday?



6) The following graph shows the cost of specials based on the quantity purchased.
(a) What is the cost of buying 4 specials?
(b) Is it more cost-effective (the cheapest per special) if you buy 6 specials or 8 specials? Explain your reasoning.
(c) What is the cost per special if you buy 10?
(d) What is the cost per special if you buy 2?
(e) What is the most cost-effective amount of specials to buy?

Plotting graphs from a table of information

7)

Using a suitable scale, plot a graph of Y vs. X for each of the following

(a)

X cm	Y cm
1	1
4	16
5	25
7	49
8	64
9	81

(b)

X cm	Y cm
1	3
2	6
3	9
4	12
5	15
6	18

(c)

X cm	Y cm
2	6
4	10
6	14
8	18
10	22
12	26

(d)

X cm	Y cm
7.04	2.2
9.36	2.6
12.7	3.1
19.1	3.9
37	5.6
56	7

8)

The volumes of different masses of a certain liquid are shown in the table below. Using a suitable scale plot a graph of the volume on the vertical axis and mass on the horizontal.

Mass(g)	30.6	53.7	85	113	146.7	189
Volume(cm^3)	35.8	62.8	99.4	132.2	171.6	221.1

9)

The cost of spraying bananas per hectare is given in the table below. Plot the graph using a scale of 1cm to represent 2 hectares on the horizontal axis and a scale of 1cm to represent $20 on the vertical axis.

Number of hectares	1	2	3	4	5	6	7	8
Cost in dollars	22.50	40	57.50	75	92.50	110	127.50	145

10)

The sine of an angle is given by the table below, plot the graph of sine x using a scale of 1 cm to 10 degrees on the horizontal axis and a scale of 1cm to represent 0.1 on the vertical axis.

Angle	0	10	20	30	40	50	60	70	80	90
Sine of angle	0	0.17	0.34	0.5	0.64	0.77	0.87	0.94	0.98	1.00

11)

The height of a plant sat different days after planting is given in the table below. Plot a graph of the height versus the number of days after planting, using a suitable scale.

Days	5	9	17	22	28	36
Height	1.2	2.16	4.08	5.28	6.72	8.64

12)

A stone thrown from the top of a mountain drops the following distances, Plot a graph of the distance to time.

Time (s)	1	2	3	4	5	6	7	8
Distance (m)	0.4	7.2	20.4	40	66	98.4	137.2	182.4

13)

The volume of different masses of liquid are shown in table below, Plot a graph of the volumes against the masses.

Mass (g)	30.6	53.7	85	113	146.7	189
Volume(cubic cm)	35.8	62.8	99.4	132.2	171.6	221.1

14) Calculate the equation of a line given two points.

(a) (4, 6) (8, 6)
(b) (1,0) (4, 9)
(c) (3,5) (6, 10)
(d) (-2,-6) (6, 12)
(e) (2,2) (2, 6)

15) Calculate the gradient from the given list of points.

(a) (0,0) (4,5)
(b) (6,7) (9,1)
(c) (3,1) (5, -3)
(d) (2,4) (5, 4)
(e) (5,2) (5, 6)

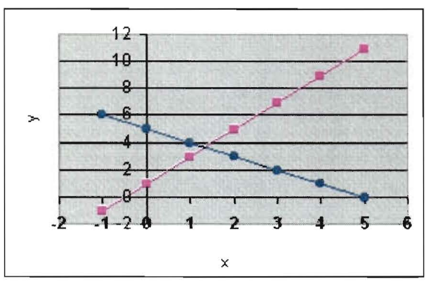
16) Determine if the following equations for lines are perpendicular, parallel or neither

(a) $y = 2x + 6$, $y = -x/2 + 3$
(b) $y = 4x + 6$, $y = x/3 + 3$
(c) $y = 12x + 6$, $y = 12x + 3$
(d) $y = x/8 + 6$, $y = -8x + 3$
(e) $y = -x/8 + 6$, $y = -8x + 6$

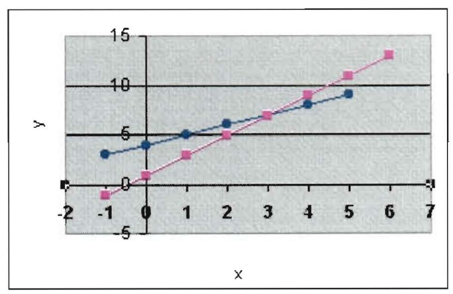
17) Find the line that passes through the point (-2, -12) and is perpendicular to the line that passes through the points (1, 2) (5, 9).

18) Solve the simultaneous Equation

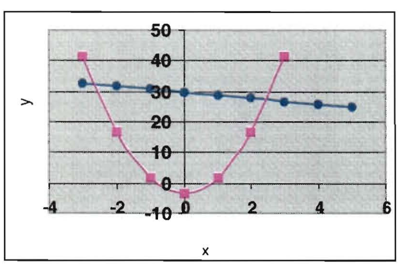
(a)



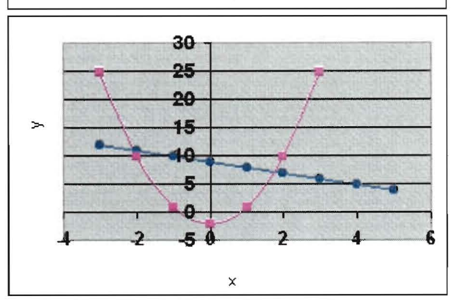
(f)



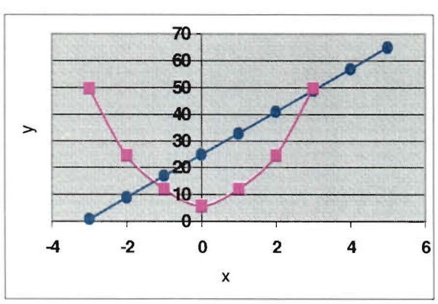
(c)



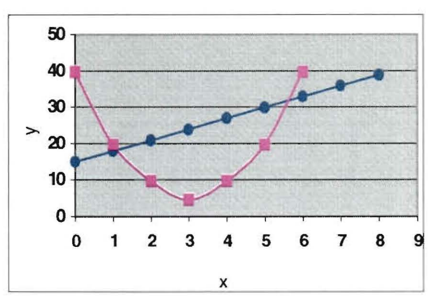
(g)



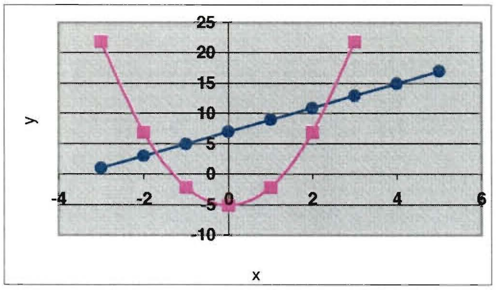
(c)



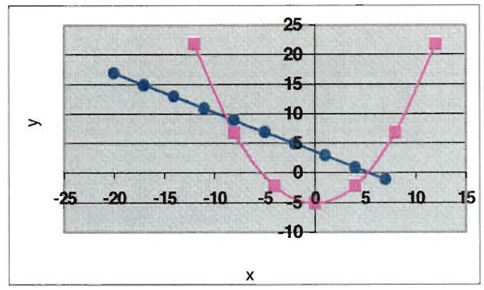
(h)



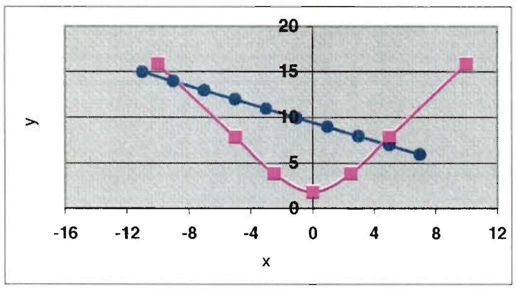
(d)



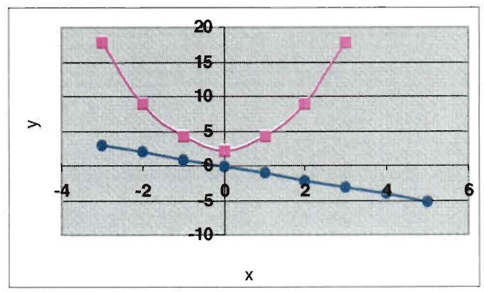
(i)



(e)



(j)



19) Inverse Variation

a) If p varies inversely as x and p is 4 when x is two, find p when x is 9.

b) If p varies inversely as x^3 and p is 6 when x is 2, find p when x is –2.

c) If you put a light source, like a light bulb, near a light meter and move the light source farther away the meter will detect a change in the intensity that varies inversely as the distance away from the source.
(d) If the meter detects an intensity of 0.2 when the light source is 6 meters away what is the value of k, the constant of variation.
(e)Use the constant of variation to find the intensity of the light when the source is 1.2 meters away

(f) If y varies inversely as x^2 and y is 96 when x is 4, find y when x = 5.

(g) If y varies in an inversely as 2x, when y is 12 x is 2 find y when x is 6.

Find the missing unknown quantity

$$y \propto \frac{k}{x}$$

(h) y =32 k = 25.6
(i) y =12 x = 7.4

$$y \propto \frac{k}{x^3}$$

(j) y =27 k = 729
(k) y = 125 x = .5
(l) k = 50 x = 5

20) Direct Variation

(**a**) If $q \propto p$ and $p = 40$, when $q = 12$, Find the value of q, when $p = 34$

(**b**) If $y \propto x^3$, and $y = 246$ when $x = 6$, Determine the constant of proportion.

(**c**) If $P \propto 2q$ and the constant of proportion, $k = 2$, when $p = 8$,find the value of q.

For the table below, answer the following questions

A	5	3	7	1
B	10	6	14	2

(d) State the relationship between the two variables A and B
(e) Using the table above, determine the scale factor for A and B
(f) If $e \propto f$ and $f = 16$, when $e = 8$, Find the value of e, when $f = 18$
(g) If $y \propto x^2$, and $y = 246$ when $x = 6$, Determine the constant of proportion, and then determine the value of y, when $x = 8$.
(h) Complete the table below such that the two variables are directly proportion with a constant of proportion = 0.5

A	5			1
B		6	14	

(i) If $A \propto 2B^2$, and $A = 246$ when $B = 16$, find the constant of proportion.
(j) Using the example above, find the value of B, when $A = 48$.

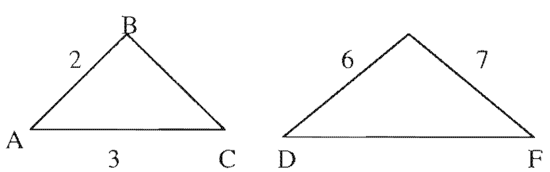
5. GEOMETRY

1) Which of the following triangles are congruent and why?

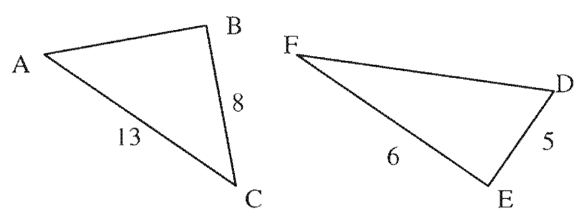
(a) $AB = GE$, $AC = GF$, $\angle A = \angle G$
(b) $AB = RS$, $BC = ST$, $AC = RT$
(c) $AC = MK$, $AB = ML$, $\angle A = \angle M$
(d) $AC = MP$, $\angle B = \angle N$, $\angle C = \angle P$
(e) $AC = PR$, $BC = QR$, $\angle B = \angle Q = 90°$
(f) $AB = ML$, $\angle A = \angle M$, $\angle B = \angle L$

2) Find the missing lengths of sides.

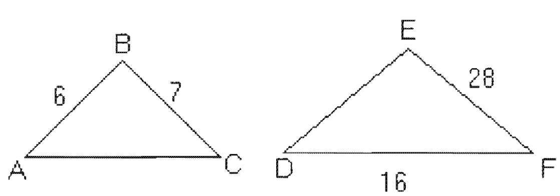
a)



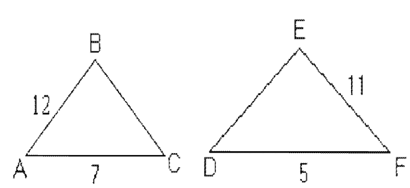
b)



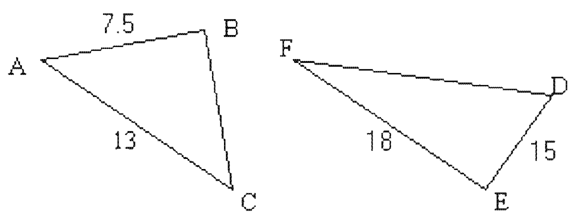
c)



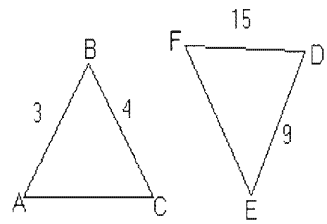
d)



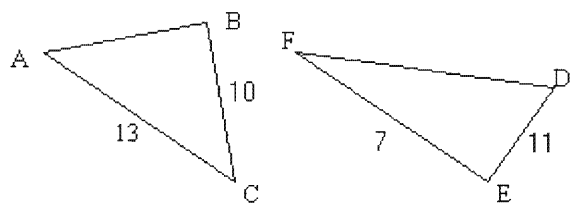
e)



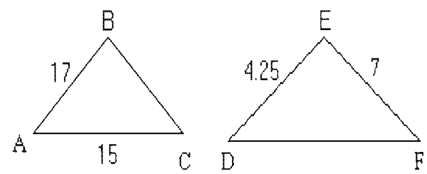
f)



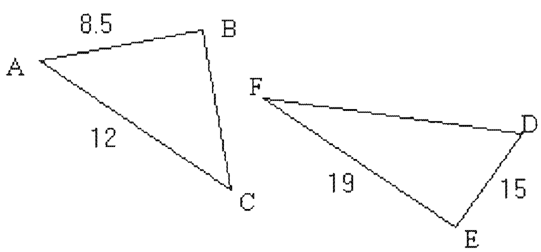
g)



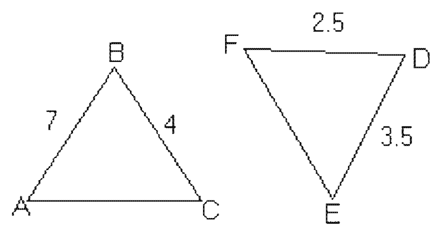
h)



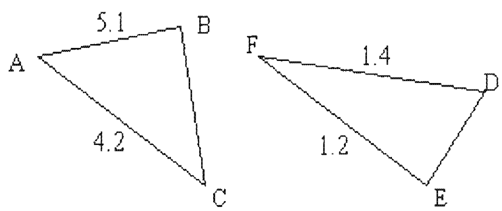
i)



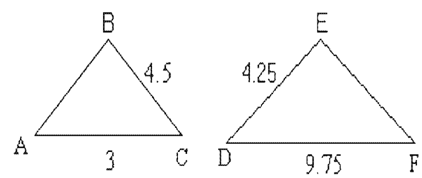
j)



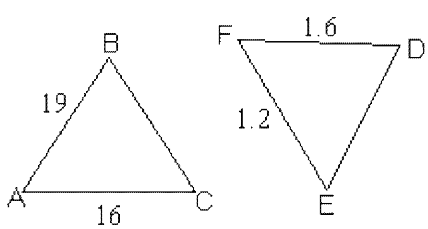
k)



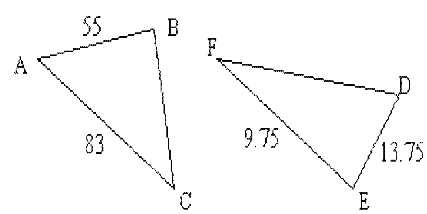
l)



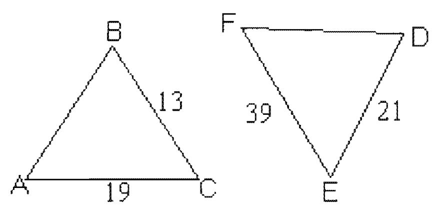
m)



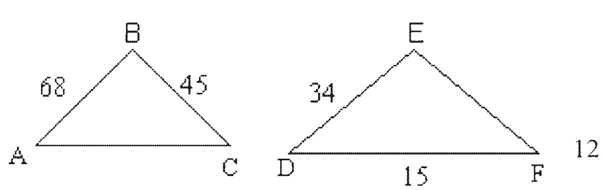
n)



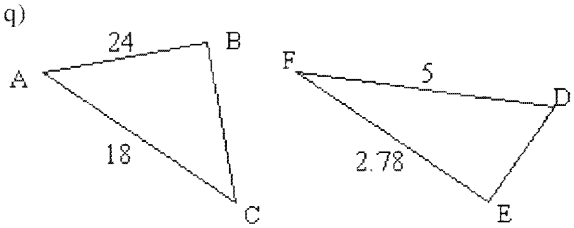
o)



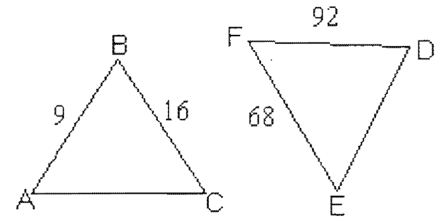
p)



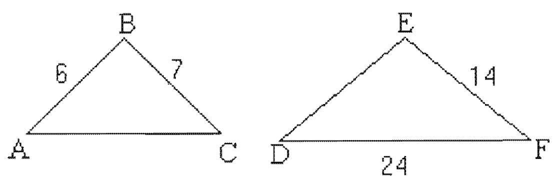
q)


A
24
B
18
C
F
5
D
2.78
E

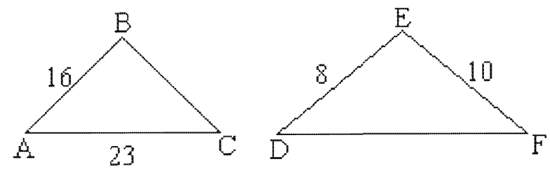
r)


B
9
16
A
C
F
92
D
68
E

s)


B
6
7
A
C
E
14
D
24
F

t)


B
16
A
23
C
E
8
10
D
F

A fresh look at...
FORM 4 MATHEMATICS
for the
British Virgin Islands High School

ANSWER KEY

by Edith Ampadu, Bill Burgess,
Jason Cobb, and Aaron Lopez.

1. COMPUTATION AND NUMBERS

1)

a) $\frac{22}{15} = 1\frac{7}{15}$ b) $\frac{16}{63}$ c) $\frac{3}{4}$

d) $\frac{13}{15}$ e) $\frac{11}{12}$ f) $\frac{13}{6} = 2\frac{1}{6}$

2)

(a) (1/16)	(e) (22/21)	(i) (-11/16)	(m) (-3/2)	(q) (1/10)
(b) (1/2)	(f) (-5/2)	(j) (1/32)	(n) (-27/10)	(r) (-20/16)
(c) (1/12)	(g) (3/8)	(k) (32/15)	(o) (-13/10)	(s) (63/16)
(d) (7/12)	(h) (-1/2)	(l) (22/45)	(p) (1/63)	(t) (59/24)

3)

(a) 5/18	(c) 48/63	(e) 2	(g) 3/8	(i) 12/35
(b) 7/5	(d) 50/27	(f) 2	(h) 9/20	(j) 56/45

4) (Selected Answers)

(a) 5/12	(d)	(g) 1/14	(j)	(m) 6
(b)	(e) 25/27	(h)	(k) 35/64	
(c) 6	(f)	(i) 3/2	(l)	

5)

(a) 53.0780	(f) 57.21367	(k) 7303	(p) 2160.784
(b) 64.9626	(g) 695.5533	(l) 49798.69	(q) 6449.296
(c) 615.54	(h) 964.9662	(m) 6432.6098	(r) 77.6291
(d) 0.1297	(i) 55.2910	(n) 71.345	(s) 268.3101
(e) 799.085	(j) 134.5601	(o) 279.5746	(t) -18.11766

6)

a) 0.471	f) 0.988	k) 2.998	p) 3.952
b) 0.157	g) 0.420	l) 1.189	q) 6.846
c) 0.656	h) 0.181	m) –0.23	r) 0.991
d) 0.012	i) 2.403	n) 4.777	s) –5.142
e) 0.422	j) 0.246	o) 0.702	t) 4.034

7)

a) $0.5 \times 7.0=$	f) $0.008 \times 8=$
b) $0.20 \times 5\ 08=$	g) $3 \times 0.008=$
c) $2.5 \times 25=$	h) $7.12 \times 0.003=$
d) $1.06 \times 10.10=$	i) $8.823 \times 0.1=$
e) $6.4 \times 0.04=$	j) $0.025 \times 0.05=$

8)

(a) 0.3	(c) 90	(e) 25 1/3	(g) 66 2/3	(i) 8
(b) 2/3	(d) 7	(f) 2.727272	(h) 91	(j) 22.2857

9)

(a) 0.6	(d) 1.222	(g) 0.588	(j) 0.38
(b) 0.545	(e) 6.5	(h) 2.75	
(c) 0.4167	(f) 0.333	(i) 0.125	

10)

(a) 23/100	(d) 51.7/100	(g) 703/1000	(j) 1183/500
(b) 19/20	(e) 633/500	(h) 1459/1000	
(c) 12/25	(f) 169/200	(i) 57/500	

11)
(a) 0.655
(b) 56.559
(c) 687.658
(d) 7.895
(e) 9.999

12)

(a) 65.1583	(e) 8.6950	(i) 0.0107
(b) 123.6857	(f) 46.5960	(j) 64.5493
(c) 964.0009	(g) 70.0108	
(d) 0.0005	(h) 4.4444	

13)

(a) 4	(c) 5	(e) 4	(g) 2	(i) 1
(b) 2	(d) 3	(f) 4	(h) 5	(j) 0

14)
(a) 0.00568
(b) 78.9
(c) 7.45
(d) 68.2
(e) 50.2

15)
(a) 65.1583
(b) 1283.66
(c) 964.009
(d) 0.000456820
(e) 8.69500
(f)

16)
(a) 65.16
(b) 1284
(c) 964.009
(d) 0.0004568
(e) 8.695

17)
(a) 5
(b) 4
(c) 5
(d) 6

(e) 2

19)

(a) $1.\times10^{3}$
(b) 1.1×10^{3}
(c) 2.782×10^{2}
(d) 3.45×10^{-1}
(e) 1.234×10^{1}
(f) 5.778×10^{2}
(g) 3.4×10^{-2}
(h) 7.724×10^{0}
(i) 5.673×10^{1}
(j) 2.0×10^{-3}

20)

(a) 1000
(b) 0.0427
(c) 17700
(d) 0.0000039
(e) 57
(f) 180000
(g) 0.0021
(h) 123000
(i) 0.667
(j) 31200

21)

(a) 1.3, 0.05, 0.05
6.5, 0.02, 0.05
3.7, 0.03, 0.05

(b) 5.4, 0.03, 0.05
4.9, 0.0, 0.05
13.5, 0.04, 0.05

(c) 9.5, 0.01, 0.05
13.5, 0.05, 0.05
12.3, 0.04, 0.05

(d) 15.4, 0.03, 0.05
39.9, 0.05, 0.05
64.1, 0.045, 0.05

(e) 3.3, 0.01, 0.05
14.2, 0.02, 0.05

(f) 86.4, 0.03, 0.05
86.4, 0.03, 0.05
86.4, 0.03, 0.05

(g) 5.4, 0.02, 0.05
8.4, 0.01, 0.05
14.8, 0.03, 0.05

(h) 76.9, 0.04, 0.05
20.4, 0.03, 0.05
59.3, 0.02, 0.05

(i) 47.1, 0.02, 0.05
72, 0.03, 0.05
5.0, 0.021, 0.05

(j) 19.2, 0.042, 0.05
82.5, 0.03, 0.05
53.67, 0.005, 0.05

(k) 23.4, 0.039, 0.05
75.6, 0.014, 0.05
7.3, 0.009, 0.05

(l) 11.33, 0.004, 0.005
21.65, 0.003, 0.005
43.69, 0.001, 0.005

(m) 16.01, 0.001, 0.005
55.75, 0.002, 0.005
12.35, 0.005, 0.005

(n) 1.12, 0.003, 0.005
40.24, 0.001, 0.005
24.02, 0.005, 0.005

(o) 69.11, 0.003, 0.005
5.12, 0.005, 0.005
36.17, 0.004, 0.005

(p) 42.36, 0.004, 0.005
70.16, 0.002, 0.005
7.31, 0.004, 0.005

(q) 62.95, 0.005, 0.005
86.24, 0.002, 0.005
58.48, 0.001, 0.005

(r) 69.51, 0.002, 0.005
46.25, 0.000, 0.005
79.44, 0.002, 0.005

(s) 26.25, 0.002, 0.005
38.27, 0.004, 0.005
6.49, 0.001, 0.005

(t) 29.41, 0.002, 0.005
44.77, 0.005, 0.005
15.52, 0.003, 0.005

(u) 63.10, 0.001, 0.005
31.43, 0.000, 0.005
17.43, 0.002, 0.005

(v) 69.114, 0.0005, 0.0005
5.115, 0.0002, 0.0005
36.175, 0.0004, 0.0005

(w) 78.183, 0.0003, 0.0005
12.630, 0.0003, 0.0005
94.515, 0.0001, 0.0005

(x) 44.445, 0.0001, 0.0005
10.157, 0.0002, 0.0005
82.524, 0.0001, 0.0005

(y) 33.552, 0.0003, 0.0005
12.534, 0.0002, 0.0005
59.289, 0.0004, 0.0005

(z) 111.439, 0.0005, 0.0005
82.874, 0.0000, 0.0005
36.281, 0.0005, 0.0005

(aa) 52.289, 0.0002, 0.0005
48.282, 0.0001, 0.0005
33.439, 0.0004, 0.0005

(bb) 13.439, 0.0004, 0.0005
88.566, 0.0005, 0.0005
92.489, 0.0001, 0.0005

(cc) 29.921, 0.0045, 0.0005
39.544, 0.00008, 0.0005
41.485, 0.00008, 0.0005

(dd) 98.213, 0.00049, 0.0005
54.129, 0.0004, 0.0005
27.590, 0.00034, 0.0005

(ee) 32.940, 0.00034, 0.0005
14.590, 0.00036, 0.0005
20.156, 0.00045, 0.0005

22)

(a) 11.326
(b) 16.011
(c) 1.123
(d) 21.653
(e) 55.748
(f) 40.239
(g) 43.689
(h) 12.345
(i) 24.015
(j) 69.113
(k) 42.356
(l) 62.945
(m) 5.115
(n) 70.162
(o) 86.238
(p) 36.174
(q) 7.314
(r) 58.481
(s) 69.512
(t) 26.248
(u) 29.412
(v) 46.250
(w) 38.274
(x) 44.765
(y) 79.438
(z) 6.489
(aa) 15.517
(bb) 63.099
(cc) 31.430
(dd) 17.432

23)

(a) 69.1135	(g) 36.1746	(m) 12.5342	(s) 13.4394	(y) 92.47891
(b) 78.1827	(h) 94.5149	(n) 82.874	(t) 29.92145	(z) 41.48508
(c) 44.4449	(i) 82.5241	(o) 48.2819	(u) 98.21349	(aa) 27.59034
(d) 5.1152	(j) 33.5523	(p) 59.2886	(v) 88.5655	(bb) 32.94034
(e) 12.6303	(k) 111.4385	(q) 36.2805	(w) 39.54392	(cc) 14.59036
(f) 10.1572	(l) 52.2892	(r) 33.4394	(x) 54.12904	(dd) 20.15555

24) Using the information given, answer the following questions.
No solutions

25)

(a) 12	(c) 45	(e) 8725	(g) 9	(i) 111
(b) 197	(d) 7367	(f) 89	(h) 62822	(j) 43

26) (Selected Answers)

(a) 40	(c) 10	(e) 131	(g) 40	(i) 50
(b)	(d)	(f)	(h)	(j)

2. MAPPING

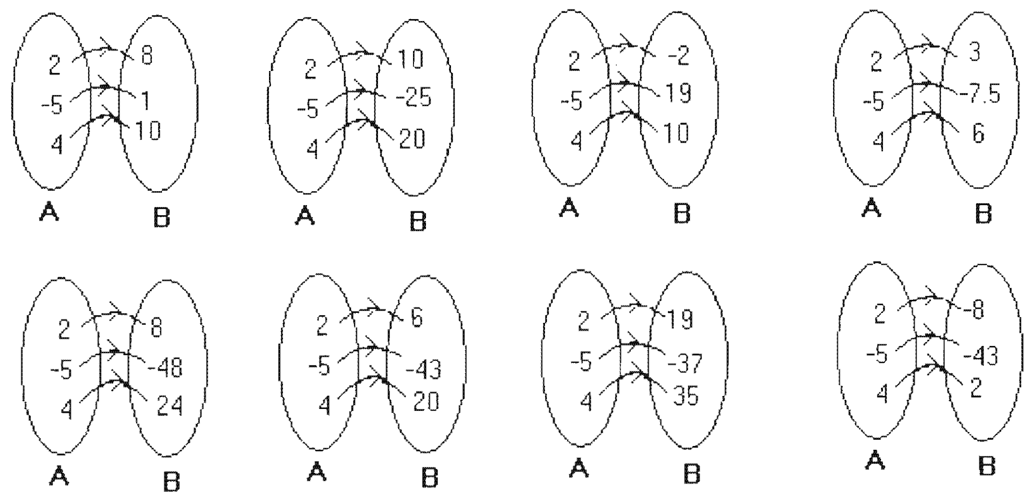
1)

(a) (6, 8, 10, 12)
(b) (-1, 2, 5, 8, 11, 14)
(c) (-6, -2, 2, 14, 22)
(d) (-15, 9, 25)
(e) (-11, -9, -5, -3, 1)
(f) (0, -1, 2, -3, -4, -5)
(g) (5, 7, 11)
(h) (-3, -24, 21, -12)
(i) (63, 27, 42, -9, 45)
(j) (24, -20, 28, -36, -42, 44)
(k) (-4, -8, -12, -16)
(l) (-14, -7, -2, 13, 23)
(m) (-1.5, 28.5, 37.5, 91.5)
(n) (-24, -17, -3, 4, 18)
(o) (-44, -14, -24, 10, -26)
(p) (7.5, 20, -12.5, 15)
(q) (36, 62, 92)
(r) (-21, -18, -15, -12, -9, -6)
(s) (73, 91, 127)
(t) (4, 10, 22, 46, 166)
(u) (62, 65, 41, 35, 20)
(v) (2, 86, -94, 38)
(w) (-618, -405, 334)
(x) (-153, -63, 27)
(y) (61, 138, 292)
(z) (-124, 96, -144, 176, 206, -224)
(aa) (24, 50, 76, 102, 128, 156)
(bb) (16, 38, 60, 82)
(cc) (-137, 157, 353)
(dd) (36, 50, 8, 78, 92, 106)

2)

(a) $x \to 2x$
(b) $x \to x/3$
(c) $x \to x$
(d) $x \to x - 10$
(e) $x \to x + 6$
(f) $x \to 6x + 2$
(g) $x \to 2x + 3$
(h) $x \to x^2 + 1$

3)



3. FUNCTIONS

1)

(a) {3, 6, 11, 18, 27}
(b) {1, 0, -3, -35, -48}
(c) {2, 3, 3, 6, 11}
(d) {-3, 1, 7, 15}
(e) {-18, -12, -6}
(f) {-16, -8, -10, -8, 4}
(g) {-12, -15, -12}
(h) {10, 4, 2, 4, 10, 20}
(i) {0, 6, 10, 14, 20}
(j) {6, -14, -30, -26, -14, 6, 34, 70}

2)

(a) {-3, -2, 1, 0, 1, 2, 3}
(b) {(-6, -6), (-5, -5), (-4, -4), (2, 2), (6, 6), (8, 8)}
(c) Yes.
(d) The function $g(x)$ is a linear function with a positive slope of 1.
(e) -1983.

3)

(a) $f(x) = x - 4$
(b) $f(x) = x/3$
(c) $f(x) = x + 3$
(d) $f(x) = 5x$
(e) $f(x) = x/7$
(f) $f(x) = x + 8$
(g) $f(x) = x/2 + 2$
(h) $f(x) = x/3 - 8$
(i) $f(x) = 5x - 75$
(j) $f(x) = 4x/3 + 16$

4)

(a) $g(f(x)) = 2x + 5$
(b) $g(f(x)) = 9x^2 - 39x + 44$
(c) $g(f(x)) = 2x - 3$
(d) $g(f(x)) = 2x + 14$
(e) $g(f(x)) = 4x - 6$
(f) $g(f(x)) = 3x$
(g) $g(f(x)) = x - 8$
(h) $g(f(x)) = 36x + 79$
(i) $g(f(x)) = 3x - 18$
(j) $g(f(x)) = x/2 + 2.5$

5)

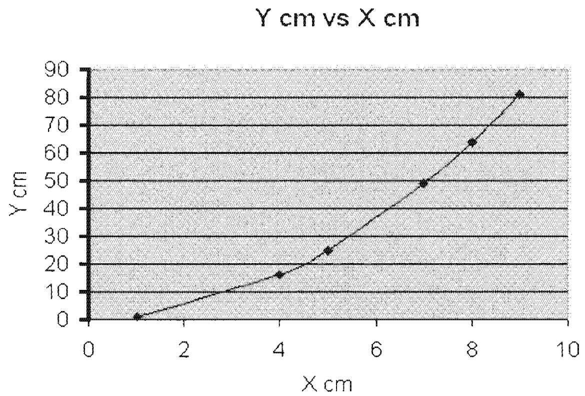
(a) $g(f(x)) = x/2 - 2.5$
(b) $g(f(x)) =$
(c) $g(f(x)) = x/2 + 1.5$
(d) $g(f(x)) = x/2 + 7$
(e) $g(f(x)) = x/4 + 0.75$
(f) $g(f(x)) = x/3$
(g) $g(f(x)) = x + 8$
(h) $g(f(x)) = x/36 - 2\ 7/36$
(i) $g(f(x)) = x/3 + 6$
(j) $g(f(x)) = 2x - 5$

4. GRAPHS I

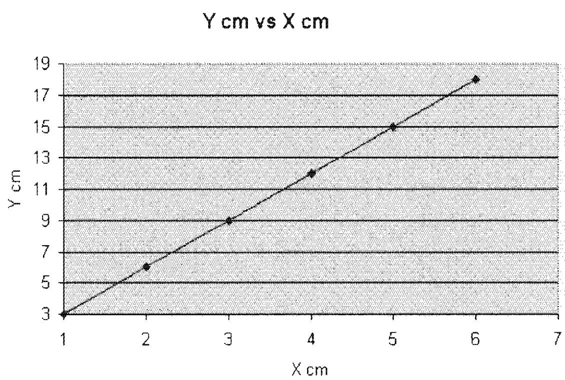
2) a) 10 b) 6-7; 62 c) 0-1=0, 1-2=3 d) more

1) a) 0-5 b) 15-20=2 c) 5-10 min. d) 15-20; 30-35
2) a) 5 b) 8 c) 100 min.
3) a) Sat. b) Thurs. c) 38 d) 82
4) a) $3 b) 8 specials, the cost per special is cheaper c) $0.59 d) $0.75 e)

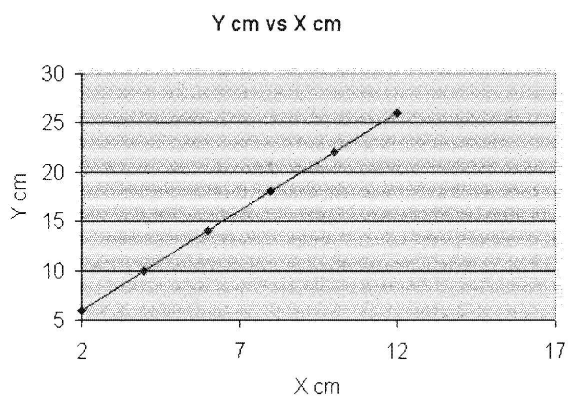
7) (a)



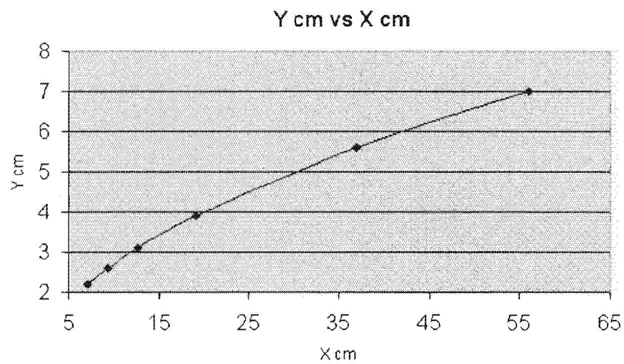
(b)



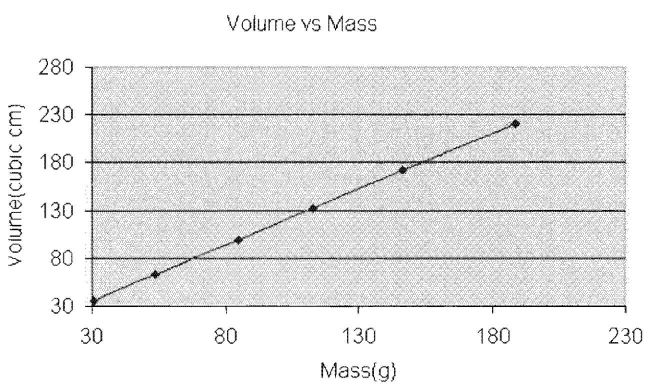
(c)



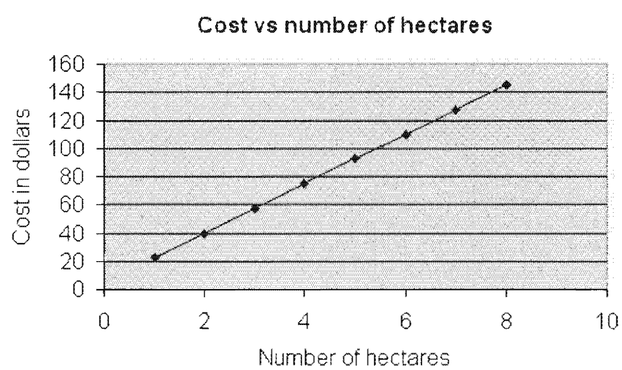
(d)


Y cm vs X cm
8
7
6
5
4
3
2
Y cm
5
15
25
35
45
55
65
X cm

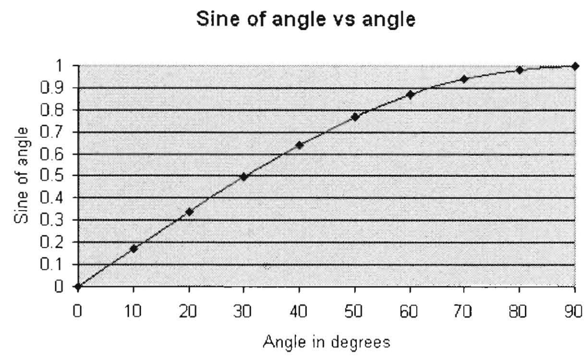
(8)


Volume vs Mass
280
230
180
130
80
30
Volume(cubic cm)
30
80
130
180
230
Mass(g)

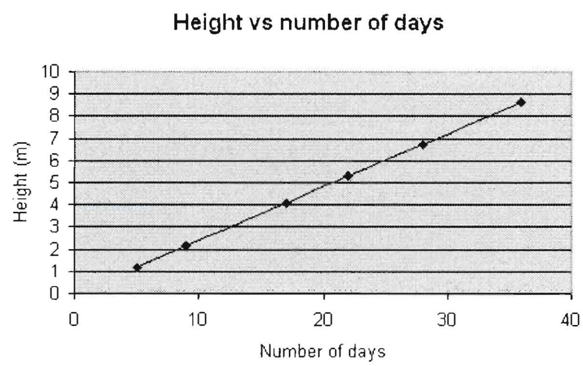
(9)


Cost vs number of hectares
160
140
120
100
80
60
40
20
0
Cost in dollars
0
2
4
6
8
10
Number of hectares

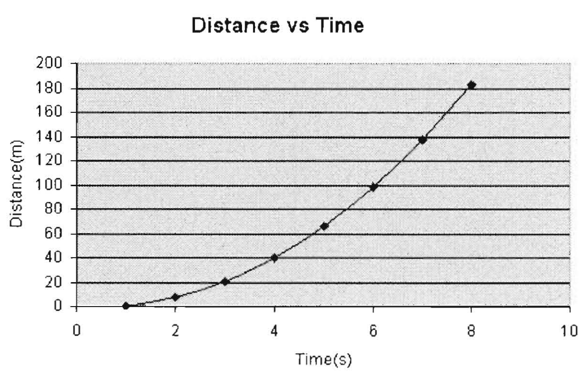
(10)


Sine of angle vs angle
Sine of angle
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 10 20 30 40 50 60 70 80 90
Angle in degrees

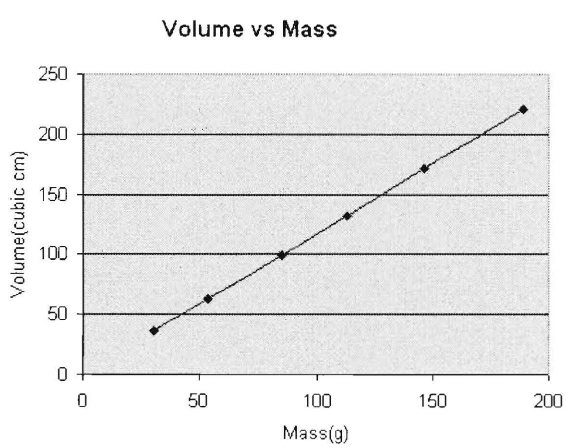
(11)


Height vs number of days
Height (m)
10
9
8
7
6
5
4
3
2
1
0
0 10 20 30 40
Number of days

(12)


Distance vs Time
Distance(m)
200
180
160
140
120
100
80
60
40
20
0
0 2 4 6 8 10
Time(s)

(13)


Volume vs Mass
Volume(cubic cm)
250
200
150
100
50
0
0 50 100 150 200
Mass(g)

14) (Selected Answers)
(a) $y = 6$
(b)
(c) $y = 5x/3$
(d)
(e) x=2

15)
(a) 5/4
(b) -2
(c) undefined

16) (Selected Answers)
(a) Parallel
(b)
(c) Perpendicular
(d)
(e) Neither

17) $y = -4x/7+10\ 6/7$

18)
(a) x=1.3, y=3.8
(b) x=2.5, y=32; x=2.5, y=28
(c) x=3, y=7
(d) x=-2, y=11; x=1.8, y=7
(e) x=-1.7, y=9; x=1.6, y=5
(f) x=–2.5, y=2.4; x=1.8, y=-1.8
(g) x=-1.8, y=4; x=2.2, y=12
(h) x=-8, y=9; x=5, y=0
(i) x=1.6, y=15; x=3, y=48;
(j) x=1, y=19; x=5.7, y=32
(k) x=-9, y=14; x=4.2, y=7 x=2, y=8;
(l) x=2.9, y=18
(m) no solution
(n) x=6.2, y=7; x=10.8, y=15
(o) x=18, y=30; x=23, y=45
(p) x=-2.5, y=2.5; x=-1, y=7
(q) x=-2, y=11; x=3, y=31
(r) x=-3, y=45; x=1.9, y=22
(s) x=-3, y=35; x=2.1, y=30
(t) no solution

19

20

(a) 10.2
(b) 1.139
(c) 2
(d) $A \propto B$
(e) 2
(f) 9
(g) 6.83, 437.3
(h)

A	5	3	7	1
B	10	6	14	2

(i) 0.48
(j) 7.07

5. GEOMETRY

1) Which of the following triangles are congruent and why?
(a) S-A-S

(b) S-S-S
(c) S-A-S
(d) R-H-S
(e) A-A-S

2) Find the missing lengths of sides.

(a) not similar
(b) similar
(c) similar
(d) similar
(e) not similar
(f) similar
(g) similar
(h) similar
(i) not similar
(j) similar
(k) similar
(l) not similar
(m) similar
(n) not similar
(o) similar
(p) not similar
(q) not similar
(r) similar
(s) similar
(t) similar
(u) BC=2.33, DF=9
(v) AB=8, DF=8.13
(w) AC=4, DE=24
(x) BC=17.6, DE=7.5
(y) BC=13.04, DF=17.94
(z) AC=5, EF=12
(aa) AB=15.73, DF=9.09
(bb) BC=28, DF=3.75
(cc) BC=10.8 DF=21.2
(dd) AC=5, EF=2
(ee) BC=3.6, DE=1.7
(ff) AB=1.31, EF=14.63
(gg) BC=12, DE=1.9
(hh) BC=39, DF=20.75
(ii) AB=7, DF=57
(jj) AC=30, EF=22.5
(kk) BC=10, DE=6.7
(ll) AC=21.6, DE=38.25
(mm) AC=12, DE=12
(nn) BC=5, DF=11.5

A fresh look at...
FORM 4 MATHEMATICS
for the
British Virgin Islands High School

TEACHER'S MANUAL

by Edith Ampadu, Bill Burgess,
Jason Cobb, and Aaron Lopez.

A Note to the Teacher

This is the manual is to be used as a supplement to the student's textbook. It contains helpful material that can be used to improve teaching. There are sections on dealing with test anxious students, and students with learning handicaps. This manual is set up such that the left page is an exact copy of the page the students see. The right page is ruled and made for adding extra helpful comments by the teachers. Some comments are shown in blue font.

Along with this text, the teacher will find forms labeled "Departmental Notes." The notes will be used to evaluate classes, and should be compiled year after year to improve teaching.

The information given is offered as the opinion of the Worcester Polytechnic Institute (WPI) students that give authorship to this work. These opinions are based on research and experiences with the students and teachers of the British Virgin Islands High School. The views and opinions presented do not represent those of *every* member of the administration of BVI HS or WPI.

TEST ANXIETY

Test anxiety is a problem facing many students today. It is characterized by subjective feelings of tension, apprehension, and worry as a result of an upcoming examination. Some symptoms to look for in test-anxious students include:

- Lack of independence
- Lack of efficiency
- Excitability
- Insecurity
- Negative self-images
- Profuse sweating
- Butterflies-in-the-stomach
- Shortness of breath
- Fear
- Quickened pulse rate
- Headaches
- Nausea
- Feelings of despair
- Shaking and trembling
- Blanking out
- Worrying

If you see a student exhibiting these symptoms, you could suggest a number of solutions. Ask the student to access his study habits. Help the student make a study plan. This type of organization will allow the student to plan and prepare his after-school life around his examinations. Make sure that the study plan has periodic breaks, about one every hour or so.

Experts say that proper exercise can help reduce stress and worry over exams. A short 15-minute walk or jog will help, but reading a book for leisure or watching clouds will count as suitable recreational activities. During the examination, tell the student to take deep breaths. If the student has mental blanks, suggest that he try word associations to help remember the material.

LEARNING DISABILITIES

Learning disabilities seem to be difficult to define, as there is not one acceptable definition. Several definitions have been proposed, putting different definitions together, for example one can say a person has a learning disability when the person's ability to learn does not meet their capacity for learning. This is true only when the ability to learn is not equal, not when there are outside confounding factors that interfere with the person's learning. Learning disabilities are a result of a mental or physiological disorder. There are several types of learning disabilities each having different symptoms and complications.

Some children develop and mature at a slower rate than others in the same age group. As a result, they may not be able to perform the expected schoolwork. This kind of learning disability is called "maturational lag."

Causes of Learning Disabilities

In some cases, children with normal vision and hearing may misinterpret everyday sights and sounds because of some unexplained disorder of the nervous system.

Most injuries occur before birth or in early childhood.

Medical problems after birth also account for some later learning problems. Learning disabilities are more common with boys than girls, possibly because boys tend to mature more slowly.

Some learning disabilities appear to be linked to the irregular spelling, pronunciation, and structure of the English language. This is because research has shown that the incidence of learning disabilities is lower in Spanish and Italian speaking countries.

Learning disabilities tend to run in families, so some learning disabilities may be inherited.

Symptoms of Learning Disabilities

It is very easy to recognize a person with a learning disability. Some of the symptoms that are usually evident in children of school going age are:

- Poor performance on group tests
- Difficulty discriminating size, shape, color
- Difficulty with temporal (time) concepts
- Distorted concept of body image
- Reversals in writing and reading
- General awkwardness
- Hyperactivity
- Difficulty copying accurately from a model
- Slowness in completing work
- Failure to see consequences for his actions
- Poor organizational skills
- Easily confused by instructions
- Difficulty with abstract reasoning and/or problem solving
- Disorganized thinking
- Often obsesses on one topic or idea
- Low tolerance for frustration
- Poor peer relationships
- Overly excitable during group play
- Behavior often inappropriate for situation
- Excessive variation in mood and responsiveness

- Overly distractible; difficulty concentrating
- Little understanding of the concept of left and right.
- Short attention span.
- Difficulty doing concrete mathematics.
- Many times over emotional or under emotional

It is necessary to know these symptoms because it is important to identify students who may have learning disabilities. For example, in an experiment, it was found that a number of students with learning disabilities make mistakes in arithmetic because they lack a secure sense of left and right. If required to do long division, they have difficulty knowing whether to work from left to right. By knowing this, the teacher can work on improving their sense of left and right. A teacher should not discourage students by focusing on topics that they have difficulty understanding.

Effects on other Students

In schools where students are grouped into classes based on their abilities, the probability that the students with learning disabilities are grouped with students who are performing below average not due to a disability is very high. For the students who are below average and do not have a learning disability, the effect is very great. There is often a lack of competition in these classes so the students do not have the chance to improve upon their capabilities. They seem satisfied with their grades and do not strive to do better, because they think they are doing excellent work compared to their peers who are not doing so well because they are disabled.

Dealing with the Learning Disabled

In order to address the needs of the learning disabled student properly, the following ten principles have been suggested by experts:

1) There is no single correct method to use with a learning disabled child. Learning disabled individuals have different ways of adapting to new things. These ways are not the same even with a particular person. New ways must be used to provide variety in all activities.

2) All factors being equal, the newest method should be used. Children with learning disabilities often tend to lose interest quickly. It has been proven that these students are often quick to adapt to new methods of instruction and tend to learn from them better. It is therefore important to continuously change the approach to teaching.

3) Some type of positive reconditioning should be implemented. The learning disabled child should not be allowed to feel as though it is his fault that he cannot reach the same levels as his peers. It is extremely necessary to boost self-esteem and build confidence.

4) High motivation is a prerequisite to success. It is important that the teacher keeps the student interested in his education. In order for the student to learn he must have a high level of interest in the topic. Many times this is done by keeping the curriculum new and refreshing.

5) The existence of non-specific or difficult to define disabilities must be recognized, particularly in older children. It is not always easy to define or diagnose a

disability in children. Each child's disability is different and has occurred for different reasons.

6) Many times it may appear that there is a learning disability, but in reality the child had a learning disability during his early stages which he grew out of. What remains is just the lag due to the early disability. Sometimes children grow up with physiological disabilities such as a visual impairment and never develop a full visual or auditory library and suffer due to the misinterpretation of sights and sounds.

7) Complete, accurate information about learning strengths and weaknesses is essential. Planning classes for the student with a learning disability should be based on their current knowledge. Different tools should be used in determining the strengths and weakness to ensure that the information obtained is up to date.

8) Symptoms often associated with learning disabilities do not necessarily indicate the presence of learning disabilities or predict future learning disabilities.

9) Education time and effort must be carefully maximized for the child with learning disabilities.

10) Learning disabilities planning should be based on a learning theory (or theories) to be most effective.

It is critically important to be concerned and involved with both process and task-oriented assistance and remediation.

LOW PERFORMING STUDENTS

Teaching the below average has a lot in common with teaching the learning disabled student, but there are important differences. These differences have to be noticed or the quality of the education given will have unfavorable effects on both the below average and the learning disabled student. Therefore it is extremely important for teachers to know which students have learning disabilities and which are just below average and need more attention. Once diagnosed it is usually necessary to separate these students at least in part. Much of their education will have common points but there are also parts in which each must have their personal needs met.

To teach the below average student a lot of time must be spent planning classes. The teacher must be well prepared and have sound reasoning for everything taught. In planning the curriculum, experts have suggested that the teacher take into account four principles:

- Education is a process, which continues throughout life.
- There should be open access to a wide range of educational choices and opportunities.
- There should be provisions for building individual competence and skills.
- The educational process should promote self-confidence and self-awareness.

If a curriculum is to be changed to address the needs of the below average student, attempts toward change must also recognize:

- It is necessary and desirable to obtain relevant, usable information about the learning difficulties of all pupils with special educational needs and to arrange for individualized learning programs for those pupils.

- It is not, however, sufficient to treat the pupil on an individual basis. Pupils are members of a multicultural society and subject to the same opportunities and stresses as everyone else. This has clear implications for the selection of curriculum content and for methods.

- The pupil has to learn within the organization of the school with all the values of its hidden curriculum.

Taking these things into account aids a teacher in designing a curriculum that best improves the student's ability.

The labs included in this manual have been provided as an example of what the BVI high school mathematics department can create or find through mathematics resources. Labs make the learning process easier for students since they tend to put the concept being taught in the context of real life. The labs provided utilize technology, which is strongly recommended, but not a requirement.

1. Calculator Wars

BASIC RULES

In each activity, students compete against each other by solving problems posted by their opponents, until you call time. The will keep score, of course. In the case of a tie, the teacher will pose a tiebreaker question to determine which of the two students gets the win.

Conduct calculator wars throughout the year with different activities introduced every month or so as the students acquire more knowledge. I have designed the activities below for an Algebra 1 class, but the idea is flexible enough to be used at nearly any level, including calculus.

Materials: Calculators with window set to "z-standard," overhead calculator and scratch paper.

Tip: It is very helpful to put up a poster with all the students' names and their current win/loss record. The competitive element strengthens the student's will to excel.

ACTIVITY 1

1. Each student draws a coordinate plane and then draws a line through it. Each quadrant is divided into 4 sub-quadrants, as shown. As you can see, this particular line enters from the left side of the upper left sub-quadrant of quadrant 3 and exits through the top of the upper left sub-quadrant of quadrant 1.

In order to avoid any argument about what is "close enough," any graph that enters from and leaves through the same side of the same sub-quadrant as the graph the student tries to copy is a correct answer.

2. The student gives his sketch to his opponent and receives his opponent's sketch in turn. He then tries to put in an equation that will generate the same graph that his opponent has sketched (the criteria for success are described above). His opponent checks his graph. If the graph is satisfactory, he gets a point and the players draw new graphs and repeat the process. If the graph is not close enough, the round continues.

3. Allow time for the students to complete at least 3 rounds before calling time.

4. *Sudden death tiebreaker:* Secretly enter an equation into your overhead calculator (while the overhead is off) and then graph it (turning on the overhead on to reveal the graph). Allow the students 20 seconds to write down the slope of the line. The closest to the right answer wins the match. Make sure that you also set your calculator to the standard window.

ACTIVITY 2

1. Each player enters the equation of a line into his calculator. The equation does not have to be in slope-intercept form.

2. The students exchange calculators and play begins. The object of this game is to change the window in such a way as to make the line look like either of the examples below. In other words, for the player to win, he must manipulate the window in such a way as to make the line appear as a diagonal across the screen from upper right to lower left, or upper left to lower right.

3. Variations of the form Y-k are prohibited here because horizontal lines do not work.

4. If a player proves that his opponent gave him the equation for something other than a line, his opponent forfeits the round (but not the match).

5. Sudden death tiebreaker – secretly enter an equation into the overhead projector, preferably one that doesn't cross the y-axis anywhere on the screen. Before showing the students the graph, tell them which window you are using (pick something somewhat strange). Show the graph and give the students 20 seconds to write down the y-intercept. The player closest to the answer wins.

ACTIVITY 3

1. Each player enters the equation for 2 lines into Y_1 and Y_2. Wise players will choose equations that result in "air graphs" when initially entered.

2. After they exchange calculators, the students must manipulate the window so that the crossing lines appear. They must then use the 2ND [CALC] INTERSECTION function to find the solution to the system of equations. Since the calculators will only find the intersection of functions displayed on the screen, the students may not skip the step of manipulating windows.

3. Encourage the players to use the table function to get initial estimates.
4. The first player to show his opponent the correct solution wins the round. As always, play continues until you call time.
5. If a player gives his opponent parallel lines and the opponent notices this, he forfeits the round. This will make the players keep a sharp eye out for equal slopes. You may even want to tell your students that you can find the slope of a line by using the 2ND [CALC] dy/dx function. This will give them a painless introduction to a little calculus terminology.
6. *Sudden-death tiebreaker_–* Graph two lines that appear on the screen with the intersection point outside of the screen. Tell the students the window you are using. Give them 20 seconds to guess the *x*-coordinate of the intersection point.

You may use variations of these lessons on other families of curves. Parabolas adapt especially well. Playing calculator wars on a regular basis will greatly improve your students' grasp of range, domain, and translation – just about all analytic geometry skills. The intensity, with which the students play and learn, is astonishing at times and extremely gratifying for the teacher. Enjoy!

1. COMPUTATIONS AND NUMBERS

1.1. Review of calculations with fractions

A fraction is a number that can be expressed in the form a/b or $\frac{a}{b}$.

- A fraction can also be defined as: $\frac{\text{part}}{\text{whole}}$, $\frac{\text{section}}{\text{whole}}$, or $\frac{\text{sum}}{\text{all}}$.
- The top number is the numerator, and the bottom number is the denominator.

$$\frac{\text{numerator}}{\text{denominator}} = \text{numerator} \div \text{denominator}$$

- Fractions express division.

$$\frac{5}{8} = 5 \div 8$$

- Equivalent fractions are fractions that have equal value. The following are equivalent fractions:

$$1/2 = 2/4 = 4/8 = 8/16 = 16/32 = 32/64$$
$$2/3 = 4/6 = 8/12 = 16/24 = 32/48$$
$$3/5 = 6/10 = 12/20 = 24/40 = 48/80$$

1.1.1. Addition and subtraction

- In order to add or subtract two fractions, the denominators must be equal. If the denominators are not equal determine the *Lowest Common Denominator* (LCD). To determine the LCD, make a list of the multiples of the denominator of each fraction, and select the lowest number that is in common. Remember that the LCD is never greater than the product of the two denominators.
- Multiply each fraction by an appropriate form of 1 so that all denominators are equal to the LCD.
- Add or subtract numerators. (The denominator is the LCD.)
- Reduce if possible.

$$\frac{1}{2} + \frac{7}{8} =$$

Step one:
Determine what the lowest common denominator is.

LCD = 8

Step two:
Multiply each side of the equation by the appropriate form of one in order to get the same denominator for both fractions.

$$\left(\frac{4}{4}\right)\frac{1}{2} + \frac{7}{8}\left(\frac{1}{1}\right) = \frac{4}{8} + \frac{7}{8}$$

Step three:
Add or subtract numerators as normal.

$$\frac{4}{8} + \frac{7}{8} = \frac{11}{8}$$

Step four:
Reduce if possible

$$\frac{11}{8} = 1\frac{3}{8}$$

Comments -- 1.1.1 to 1.1.4 Operations with fractions

When reviewing computations and numbers with students, it is beneficial to use a more traditional approach. It is best to go over the rules of computations many times. A majority of students at this level understand how to do the math, the problem is their tendency to forget the steps of how to do the various computations.

Retention

To help students remember the different steps in doing the various computations in this section it is helpful to have the students write out the steps used to perform the many computations for a homework assignment. This may seem as a waste of time, due to the fact that the student will copy it from a book, but if the students do the work on their own, many items they will retain much of the information they is writing.

Teachers Notes 1.1 Review of calculations with fractions

Visual Learning

Here, try to give the students a graphic representation of the placement of the numerator and the denominator. Show the students that a fraction can be written with a horizontal bar or a diagonal bar between the numerator and the denominator, or as the division of two numbers.

1.1.2. Multiplication

To multiply fractions, multiply the numerators, multiply the denominators, and place the product of the numerators over the product of the denominators.

$$\frac{4}{5} \times \frac{15}{16} = \frac{4 \times 15}{5 \times 16} = \frac{60}{80} = \frac{3}{4}$$

Try some for yourself:

A) $\frac{1}{8} \times \frac{3}{5} =$

B) $\frac{7}{9} \times \frac{6}{8} =$

Here is a harder example:

$$2\tfrac{3}{4} \times 1\tfrac{1}{2} = \frac{11}{4} \times \frac{3}{2} = \frac{(11 \times 3)}{(4 \times 2)} = \frac{33}{8} = 4\tfrac{1}{8}$$

1.1.3. Division

To divide a number by a fraction follow the steps in this example:

change division to multiplication

$$\frac{4}{5} \div \frac{8}{9}$$

$$\frac{4}{5} \times \frac{9}{8}$$

change the divisor (the second number) into its reciprocal

use cross reduction to make multiplication easier.

$$\frac{\cancel{4}^{\,1}}{5} \times \frac{9}{\cancel{8}_{\,2}}$$

make sure answer is in simplest terms

$$\frac{9}{10}$$

Comments -- 1.1.2 and 1.1.3 Multiplication and Division of Fractions

This section may seem simple and the student may find it east, but do not quickly skim over it. Students are often able to do this topic, but they tend to quickly forget it. You need to make sure the student actually learns the topic and does not memorize it for a short time.

1.2. Review of calculations with decimals

The decimal system and decimals are based on tenths or the number 10.

- The digits to the right of the decimal point are called decimal fractions.
- The decimals that do not have digits to the left of the decimal point are written 0.95 or .95. To make it easier for the reader, it is suggested to write these decimals with a zero to the left of the decimal. This helps the reader notice that the number is a decimal, as opposed to a whole number.
- The digits to the right of the decimal point correspond to tenths, hundredths, thousandths, ten-thousandths, hundred-thousandths, etc. For example, the digits in the number 59.75498 correspond to:

  5 → tens, 9 → ones, 7 → tenths, 5 → hundredths, 4 → thousandths, 9 → ten-thousandths, 8 → hundred-thousandths.

- The decimal point is always present after the ones digit, even though it may not be present. For example:

  7=7.0=7.00=7.000=7.00000=7.0000000

  29=29.0=29.0000=29.000000=29.0000000000

- Prefixes correspond to decimal fractions used to describe measurements or quantities in various units, such as grams, seconds, liters, meters, etc. The following is a tabulation of the prefixes with their corresponding decimal representation.

0.1	10^{-1}	deci
0.01	10^{-2}	centi
0.001	10^{-3}	milli
0.000001	10^{-6}	micro
0.000000001	10^{-9}	nano
0.000000000001	10^{-12}	pico
0.000000000000001	10^{-15}	fempto

1.2.1. Addition and subtraction

Add zeros to the decimals until all the numbers have the same number of decimal places. Line up the numbers and start adding them up from right to left ignoring the decimal places.

Place the decimal point in the answer so that it lines up with the number being added or subtracted

Disability Note 1.2.1 to 1.2.4 Decimal Operations

This is one area in mathematics that can make many learning disabilities and disorders obvious. But to notice if they are present you will need to pay close attention. Many times a teacher has a student who seems prone to making many so called "dumb mistakes". The student usually gets the blame and is called careless. But if you take the time and go through the errors and mistakes you may notice a pattern. If you do notice a pattern and it is considered a symptom of a disability you should recommend that student to a guidance counselor.

Teachers Note Decimal Operations -- Metric system

The metric system is an extremely important concept which students will need to understand for the rest of their lives. The best way to help students understand this, is to separate the prefix from the base unit. Show them how the prefixes values are constant no matter the unit whether mass (grams) or volume (liter). Students memorize information in many different ways. To be a more effective teacher it is good to keep this in mind. Try using visual and auditory repetition to help the students remember the meaning of each metric prefix.

i.e. 4.36 + 7.2 + 6.314

$$\begin{array}{r} 4.360 \\ 7.200 \\ +\underline{6.314} \\ 17.874 \end{array}$$

1.2.2. Multiplication

In order to multiply decimal numbers, multiply as though there are no decimal numbers. Move the decimal from the right of the product the number of places equal to sum of the number of places of the numbers being multiplied.

Example:

3.$\underline{14}$ x 2.$\underline{6}$
3 14 x 2 6 = 8 164

therefore, the result is 8.$\underline{164}$.

1.2.3. Division

When dividing a number by a quantity containing a decimal write the problem in standard form. Next move the decimal in the divisor to the right such that the divisor is a whole number, noting the number of places moved. Move the decimal in the quotient to the right an equivalent number of places adding zero place holders if necessary. Next copy the decimal directly up above the division symbol. Divide as normal. The answer will contain a decimal in the correct location.

Example:

$$\boxed{\begin{array}{r} ? \\ 0.5\overline{\smash{)}10} \end{array}}$$

$$\begin{array}{r} ? \\ 5.\overline{\smash{)}100.} \end{array}$$

Step One:
Move the decimal point in the divisor and the dividend to the right until there are no digits to the right of the decimal point in the divisor, inserting zeros as required.

$$\begin{array}{r} 2?. \\ 5.\overline{\smash{)}100.} \\ \underline{10} \end{array}$$

Step Two:
Divide 5 into 10.

Teacher's Note Multiplication and Division of Fractions.

When doing examples and assigning homework problems, make sure to assign examples the cover a spectrum of possibilities. For example, use examples where the numbers begin multiplied or divided have different numbers of significant figures.

Extension.

Assign problems that allow students to see patterns. These patterns will help them determine if their solutions to problems are correct. For example in this section assign problems that will allow students to see that if a number is multipleid by a number less than one the result will be less than the original number, or if a number is divided by a number less than one the result will be greater than the original number.

$$
\begin{array}{r}
2?.\\
5.\overline{)100.}\\
10\\
\hline
000
\end{array}
$$

Step Three:

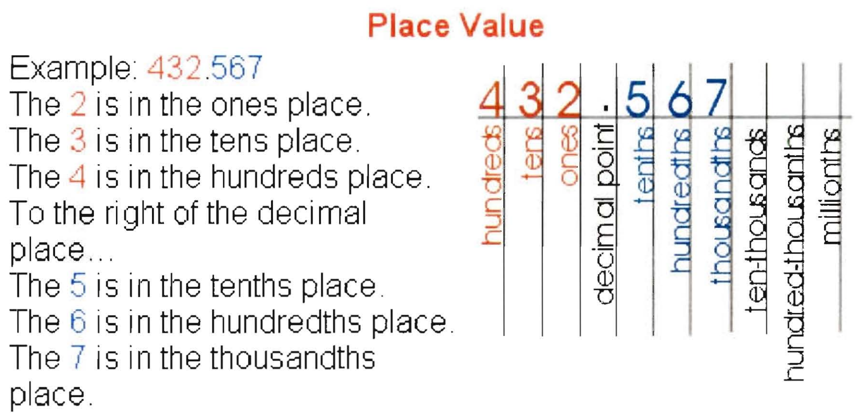
Subtracting 10 from 10 results in 0. Then bring down the last zero from the "10**0**".

$$
\begin{array}{r}
20.\\
5.\overline{)100.}\\
10\\
\hline
000
\end{array}
$$

Step Four:
There is nothing for 5 to divide into, so place a zero above the last zero in the dividend.

Therefore, $10 \div 0.5 = 20.$

1.3. Convert a fraction to a decimal and vice versa



The number is read as:
"Four hundred thirty-two and five hundred sixty seven thousandths."

The relationship between this decimal and its corresponding fractions:

$$\frac{5}{10} = 0.5 = \text{Five-tenths}$$

$$\frac{56}{100} = 0.56 = \text{Fifty-six hundredths}$$

$$\frac{567}{1000} = 0.567 = \text{Five hundred sixty-seven thousandths}$$

- As you might have guessed from the definition of a fraction, the dividing of the numerator by the denominator results in the decimal equivalent for a given fraction.

- To convert a decimal to a fraction, just read the decimal as if it is a whole number adding the suffix for the smallest place value reached by the decimal. For the example above, thousandths is the smallest decimal place reached by the decimal.

Conversion of fractions and decimals

Stress this area heavily, as it will be a needed skill for years to come. Also remember to stress that the student remember important decimals and repeating decimals.

1.4. Round off numbers

To round off decimals, the last retained digit should either be increased by one or left unchanged according to the following rules:

- If the leftmost digit to be dropped is less than 5, leave the last retained digit unchanged.

- If the leftmost digit to be dropped is greater than or equal to 5, increase the last retained digit by one.

<u>Example</u>:

5.4	rounds to	5.
2.5	rounds to	3.
45.64	rounds to	46.

To round off to a certain number of significant figures, ignore all zeros and start counting from the first integer taking into account all numbers including zero thereafter, until the number of significant figures is obtained. If the number after the last number required is greater than five, add one to the last number.

i.e. 0.024 to 1 significant figure is 0.02.

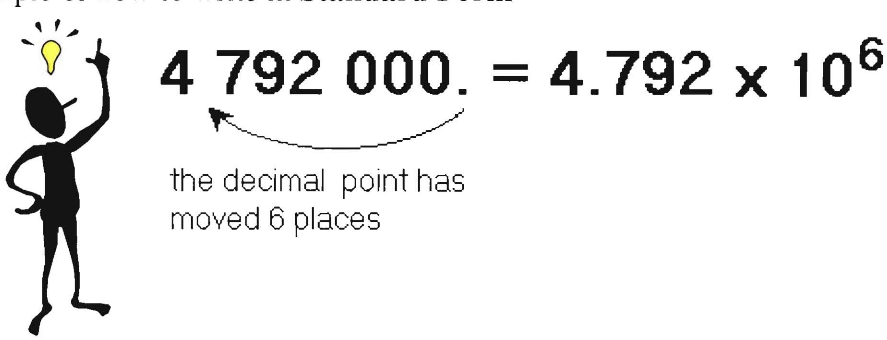
1.5. Review of rules for indices

The following rules of indices explain how to work with numbers containing exponents.

1. $a^n \times a^m = a^{n+m}$
2. $a^n \div a^m = a^{n-m}$
3. $a^0 = 1$
4. $a^{-n} = 1/a^n$
5. $(a^n)^m = a^{nm}$
6. $(a/b)^{-n} = (b/a)^n$

1.6. Standard form

Example of how to write in **Standard Form**



Comments -- 1.5 Rules of indices

Stress this section. This section may be a good area to go over every several weeks or so.

Use the following steps to write a number in standard form:

1) Working from left to right, insert a **new** decimal point after the first nonzero digit in the number.
2) Round the new number off to the number of places for desired accuracy. Write " x10 " after the rounded number.
3) Count the number of places the decimal moved from its **new** location to the **old** location. When counting from left to right, this value is positive, if counting from right to left, this value is negative.
4) Write the value you calculated in the previous step as the power to which 10 is raised.

1.7. Errors in measuring

When making measurements, it is important to note the greatest possible error. Some measurements will need to be very precise, while others need not be so exact. Knowing the greatest possible error will allow you to determine if your result is valid enough for what you are measuring.

The greatest possible error is based on how numbers are rounded. If a number is rounded to the one decimal place, the greatest possible error is +/- 0.5. If a number is rounded to two decimal places, the greatest possible error is +/- 0.05. If a number is rounded to three decimal places, the greatest possible error is +/- 0.005. Therefore, the more precise you want to be, the more decimal places you need to use.

Look at the following table:

Original No.	Rounded To	# Decimal Places	Error	Greatest Possible Error
9.4	9.0	1	-0.4	+/- 0.5
9.5	10.0	1	+0.5	+/- 0.5
9.54	9.50	2	-0.04	+/- 0.05
9.55	9.60	2	+0.05	+/- 0.05
9.554	9.550	3	-0.004	+/- 0.005
9.555	9.560	3	+0.005	+/- 0.005

1.8. Degree of accuracy

The degree to which a number is accurate depends on the number of decimal places to which it is written. A number written to a higher number of decimal places is more accurate than one written to a fewer number of decimal places. With a list of numbers, the set is as accurate as the least accurate term. For example, if you have (2.5cm, 2.62cm, 2.7cm), 2.62cm is the odd one out, meaning that 2.62cm is more accurate than the other two measurements. However, when these numbers are being added, the members of the list must be written to the same number of decimal places as the least accurate term. For the previous example, the numbers added would be 2.5cm+2.6cm+2.7cm, totaling 7.8cm.

Comments -- 1.7 Errors in measuring

Given just numbers to work with, students many times find this to be an easy topic. To challenge them, try to make up some real life situations that require specific degrees of accuracy, and have them determine if the task is feasible under the specified conditions.

Comments -- 1.8 Degrees of accuracy

This topic will most likely be easy for students. But they almost always think of it as unnecessary. To effectively demonstrate its purpose it may be a good idea to have the science department introduce it at the same time.

1.9. Base Numbers

As you most likely already know our number system is based on ten. If you take a moment, you should be able to explain why. **You got it --** we have ten fingers, on which you probably originally learned to count and do math. But for some reason a few other cultures in the world decided to base their number system on things other than one. That is how base numbers first came into existence. Now that we are entering the computer era, however, people have noticed that computers and machines understand other number systems much easier. You might already know of a very popular one, binary, that's the number system with just ones and zeros. This makes sense since it is easier and faster for a computer to think in just ones and zeros or on and off.

1.9.1. Convert from one base to another

When converting a number from a base other than 10 to base 10 is simple. To do this take the sum of each digit multiplied by the base raised to the exponent whose value is equal to place value of the digit. For example in base 5:

$$2414_5 = 2\times5^3 + 4\times5^2 + 1\times5^1 + 4\times5^0 = 359$$

In base 2:

$$1011_2 = 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 = 11$$

To convert a number from base 10 to another base, write down the starting value in the first column of the conversion table. Divide that number by the base. If the result is a whole number then write down the result in the result column and a zero in the remainder column. If the number does not divide evenly then write down whole number of the result in the result column and the appropriate remainder in the remainder column. Continue doing these steps writing down the results and remainders below the previous result and remainders until the final division leaving only a remainder. The final answer for the conversion is read from the remainder column read from bottom to top.

Example:
Convert 25 from base 10 to base 2:

number	result	remainder
25		

Here the number being converted is entered in the first column.

number	result	remainder
25	12	1

Here the base is dividing the original number for the first time. The result is 12 with a remainder of one. These values are entered in the appropriate boxes.

number	result	remainder
25	12	1
12	6	0

Base Numbers

Many times students fail to see the importance of number bases. This is a good time for the teacher to make some real life examples. For example binary with computers.

Converting between bases

Converting between number bases can be a very difficult topic for students to grasp. But the method demonstrated in the text has been shown to work well.

Here the same process is repeated once again by dividing the result by the base two again, this time resulting in a whole number with a remainder of zero.

number	result	remainder
25	12	1
12	6	0
6	3	0
3	1	1
1	0	1

This process is repeated until the final time when the result equals 0. The final answer is read from bottom up. Thus 25 in base 10 is equal to 11001 in base 2.

1.9.2. Add in bases

Adding numbers in bases other than ten is quite similar to adding numbers in base 10. When you add two numbers in base 10 you add the numbers as normal and if the result exceeds or equals the base (10) you carry 1, and add the remainder. When adding numbers in other bases you follow the same technique.

Example:
Adding in base 2:

$$\begin{array}{r} 11 \\ +1 \\ \hline 100 \end{array} \quad \begin{array}{r} 101 \\ +10 \\ \hline 111 \end{array} \quad \begin{array}{r} 10 \\ +1 \\ \hline 11 \end{array}$$

In base 3:

$$\begin{array}{r} 2 \\ +1 \\ \hline 10 \end{array} \quad \begin{array}{r} 2 \\ +2 \\ \hline 11 \end{array} \quad \begin{array}{r} 21 \\ +22 \\ \hline 120 \end{array}$$

1.9.3. Subtract in bases

Subtracting numbers in bases other than 10 is also very similar to subtracting numbers in base 10. When subtracting two numbers in base 10 you subtract as normal, unless in a particular column the number being subtracted from is smaller than the number being subtracted. In this case you borrow 10 from the base in the next column reducing it by one and adding it to the number being subtracted from, and subtract as normal. When subtracting in other bases you follow the same procedure.

Example:
Subtracting in base 4:

$$\begin{array}{r} 21 \\ -3 \\ \hline 12 \end{array} \quad \begin{array}{r} 32 \\ -23 \\ \hline 3 \end{array}$$

In base 5:

$$\begin{array}{r} 21 \\ -3 \\ \hline 13 \end{array} \quad \begin{array}{r} 31 \\ -23 \\ \hline 3 \end{array}$$

Addition and subtraction of number with different bases.

This topic can be very difficult for the student to grasp. Do a lot of examples. If possible leave yourself open for extra help.

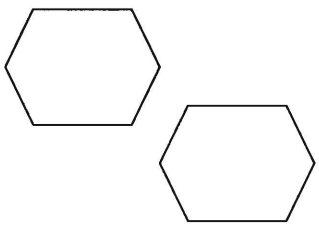
2. GEOMETRY

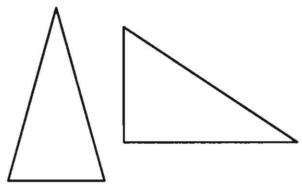
Geometry is the study of shapes, figures, and areas. This important topic in mathematics is unlike any other topic you have covered or will cover. Geometry does not depend so much on numbers; its main focus is on the relationship between objects.

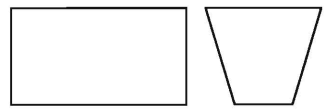
2.1. Congruency

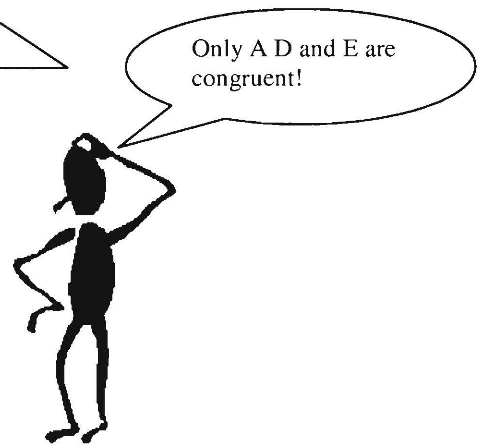
Shapes that are equal in all respects, (including shape, size of angles, and length of sides) are **congruent**.

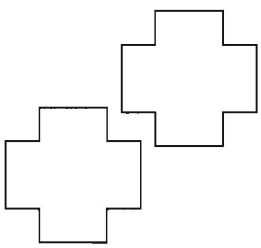
Are the following pairs of shapes *congruent*?

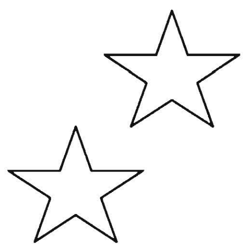
A) 

B) 

C) 

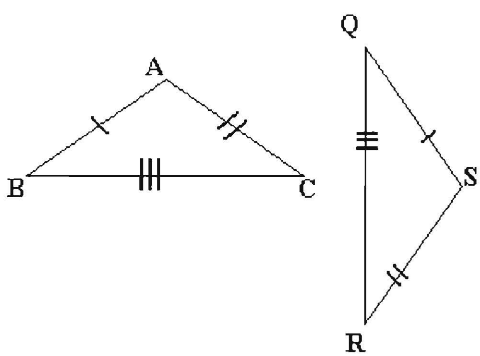


D) 

E) 

2.1.1. Congruent triangles

Here, we see some common notations used to show congruency between sides. The ticks tell us which sides are equal in length. Therefore AB = SQ, AC = SR, and BC = QR.



With this knowledge, we can say that triangle ABC is congruent to triangle SQR, or $\Delta ABC \equiv \Delta SQR$. The $\equiv$ sign means "*congruent to*". If you trace triangle ABC and fit it onto triangle SQR, you'll find angle A fits onto angle S, B onto Q, and C onto R. We say $\angle A$ **maps** onto $\angle S$ or $\angle A \rightarrow \angle S$. Complete the mapping:

$\angle B \rightarrow$

$\angle C \rightarrow$

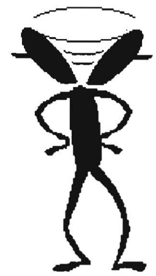
Visual Learning with Technology

Using Geometer's Sketchpad teachers are able to teach students with the discovery method. This method where the students discovers all the relationships and principles on his own is becoming widely accepted, and has been proven to work in many environments. Using the technology appendix, students can easily learn topics in geometry such as congruency, similarity, and angles in circles.

Make sure that students understand that for congruency to occur, shapes must have equal sides and angles. Explain the difference between congruency and similarity. Some teachers find it easier to tackle both congruency and similarity together allowing time to discuss the difference between the both.

It is important to realize that the order of the letters in the congruency statement are significant. For example, if we know ΔDEF ≡ ΔPUY, then we know the following six things:

ΔD → ΔP
ΔE → ΔU
ΔF → ΔY

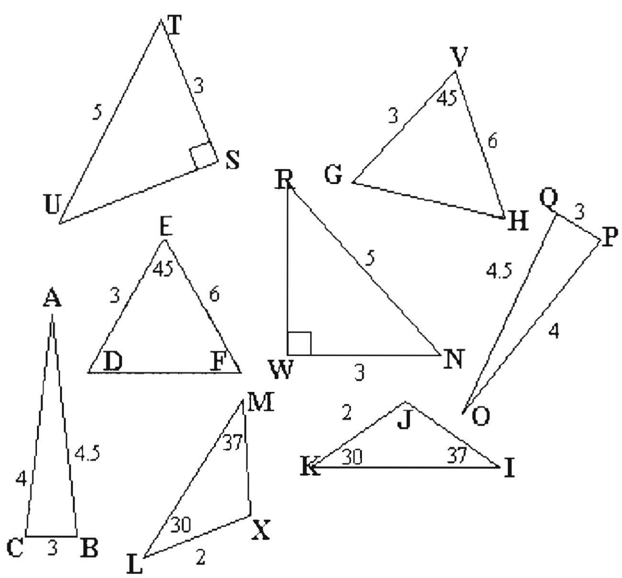


DE = PU
DF = PY
EF = UY

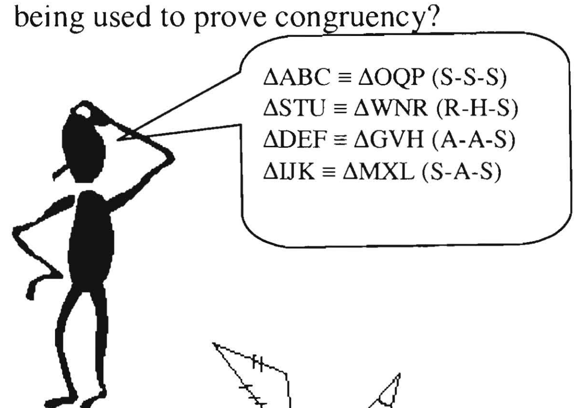
2.1.2. Congruency postulates

Two triangles are congruent if:

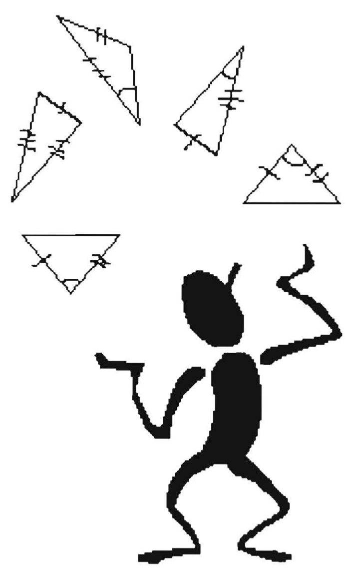
1) three sides of one triangle equal three sides of the other (S-S-S)
2) two sides and the included angle of teach are equal (S-A-S)
3) two angles and a corresponding side of each are equal (A-A-S)
4) both have a right angle, and the hypotenuse and a corresponding side of each are equal (R-H-S)



Which pairs of triangles on the left are congruent, and which postulate is being used to prove congruency?



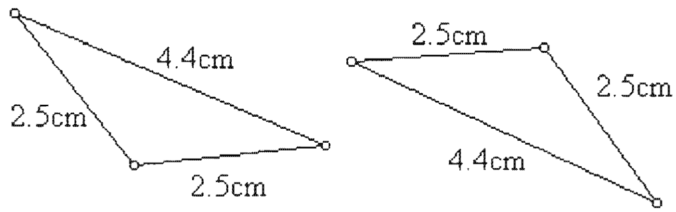
Which of the triangles that Mr. Bean is juggling are congruent, and why?



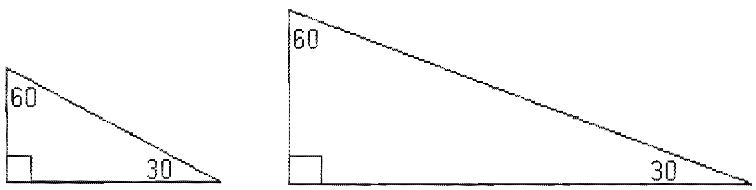
2.2. Similarity

Similarity is when two triangles either have three sides in common, three sides proportionally alike, or three angles in common.

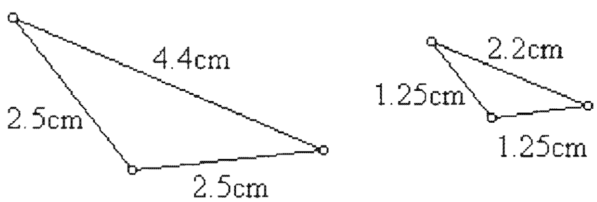
<u>Take a look at the following examples</u>:



These two triangles are similar because they have similar sides.



These two triangles are similar because they have similar angles.



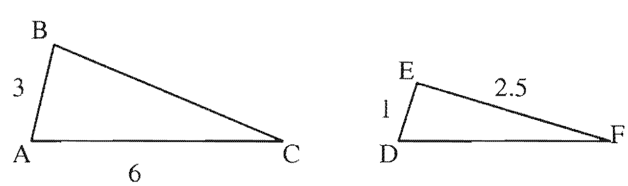
These two triangles are similar because their sides are equal in proportion. For example:
$1.25 \times 2 = 2.50$
$2.20 \times 2 = 4.40$

5.2.1 Finding missing edges in similar triangles

Similar triangles are useful for a number of reasons. One of the reasons that similar triangles are helpful is because you can find unknown sides on one if you know enough information about one similar to it.

In order to determine missing sides in triangles, simply set up ratios.

<u>Example</u>:



Discuss the use of the work ***similar*** in English compared to its use in mathematics. Point out that you may say "these two sweaters are similar" because they have the same color or pattern, not because they have the same shape and their corresponding "dimensions" are proportional.

Make sure the students understand that similarity ratio is dependent on the order of the similarity statement.

Auditory Learning

Students will better understand the properties of proportion if they describe how the properties are related to the original proportion. For example, the first property can be stated as the "product of the extremes is equal to the product of the means." The third property can be stated as the "ratio of the numerators of the proportion is equal to the ratio of the denominators of the proportion."

Visual Learning with Technology

Similarity can be best seen visually with software that allow manipulation of shapes.. One method would be to draw a triangle with fixed angle sizes, then increase of the size of the object, showing students that the rations of the sides remain constant. *Geometer's Sketchpad* is excellent software that allows students to investigate these properties in-groups or alone.

Given that triangles ABC and DEF are similar, you know that lengths AB and DE are proportional. Therefore, the ratio between the two triangles is AB:DE or 3:1. All of the lengths of triangle ABC will be 1/3 the size of their corresponding side on triangle DEF.

$$\frac{AB}{DE}=\frac{BC}{EF} \qquad \frac{3}{1}=\frac{BC}{2.5}$$

Therefore, BC=7.

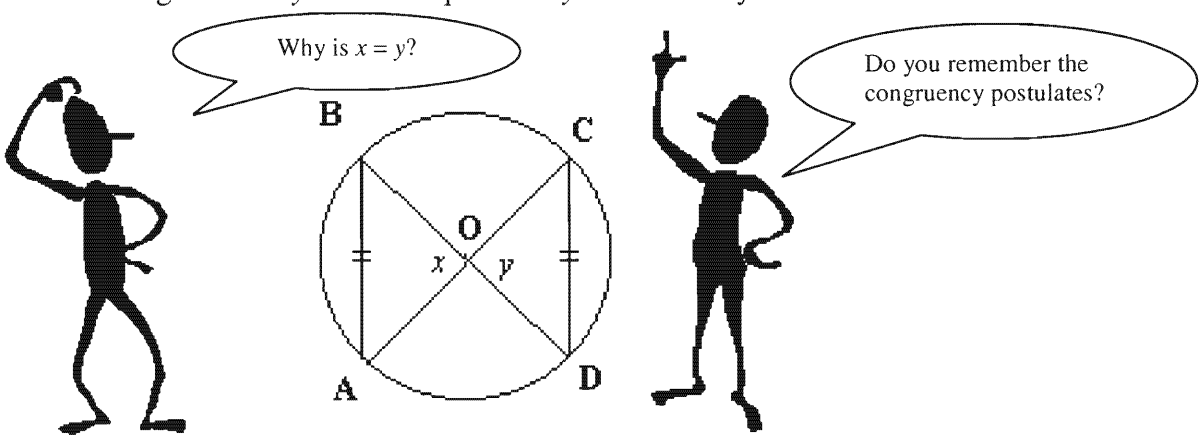
Using a proportion, you can also determine DF.

$$\frac{AB}{DE}=\frac{AC}{DF} \qquad \frac{3}{1}=\frac{6}{DF}$$

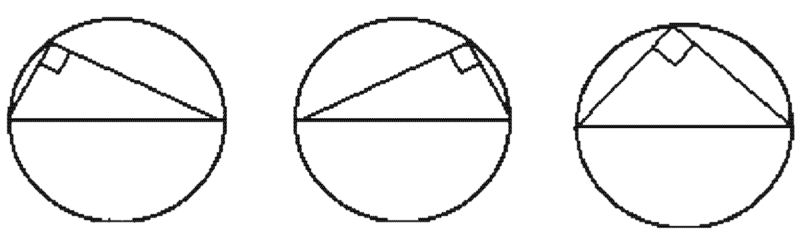
Therefore, DF=2.

2.3. Angles and Circles

In the example below, if we know that chords AB and CD are equal in length, then we know that angles x and y are also equal. Do *you* know why?



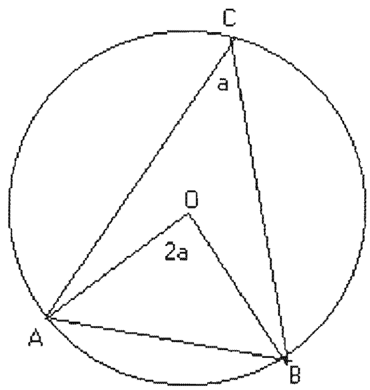
In the next example, we can see an angle in a *semi-circle* is always 90 degrees, regardless where the two chords join.



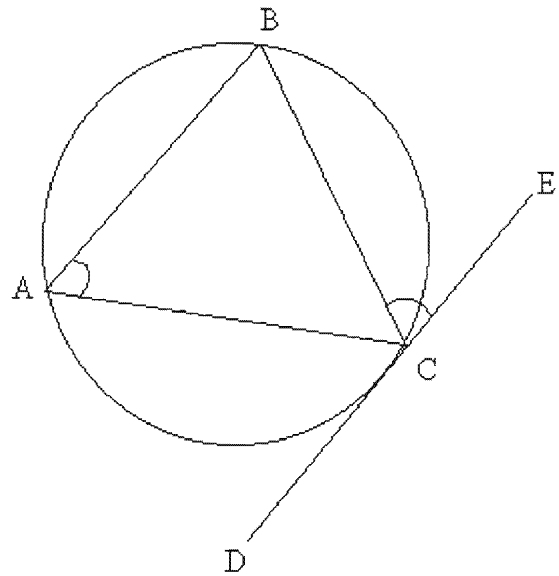
Visual Learning with Technology

This section more than any other can benefit from the use of *Geometer's Sketchpad,* especially when taught with the discovery method. Have students draw circles with inscribed triangles. Measuring all angles, then dragging one point around the circle will show students the relationship with angles in circles.

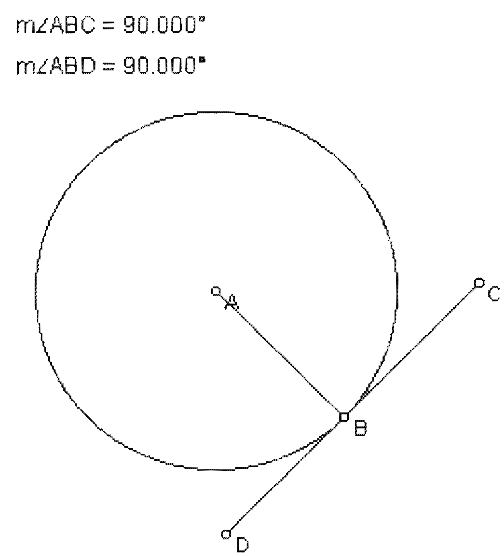
There are other special features with angles in circles. Say you have a circle with a chord 'AB' and a center 'O'. The angle formed at the center of the circle, AOB, is twice as much as angle ACB. Angle AOB is formed by connecting the end points 'A' and 'B' of the chord to the center of the circle. Connecting the end points of the chord to a point 'C' that is on the other side of chord 'AB' forms Angle ACB. If point 'C' is not on the other side of the chord, this idea will not prove correct.



Given a circle with a chord, the angle formed between the chord and a tangent drawn to the circle form an angle equal to the angle located on the circumference of the circle joining the endpoints of the chord.

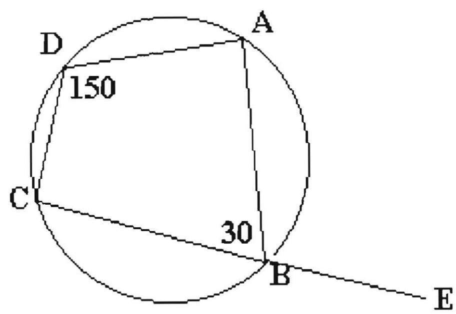


A tangent is a line that is perpendicular to another line. The importance of a tangent line now is that we will consider one with respect to the radius of a circle. The angle between a tangent line and a radius is always 90°.



2.4. Cyclic Quadrilaterals

A cyclic quadrilateral is a quadrilateral that is drawn in such a way that the corners of the quadrilateral are on the circumference of the circle. In a cyclic quadrilateral the sum of opposite angles is 180°. Consider the figure below and develop the relationship between the exterior angle and the opposite interior angle.



Since ∆CDA and ∆ABD are opposite angles in a cyclic quadrilateral they add up to 180°. CBE is a straight line so it means that the ∆ABC and ∆ABE should add up to 180°. We know that ∆ABC is 30°. That means ∆ABE = 180°-30° =150°. This means that ∆ADC = ∆ABE. This rule can be stated as "an exterior angle and its opposite interior angle in a cyclic quadrilateral are equal."

3. Appendices

3.1. Equation Editor

The equation editor is used to enter functions to be graphed or evaluated. To display the equation editor, press **GRAPH + F1**. The GRAPH menu shifts up and the equation editor menu is display as the lower menu. You can store up to 99 functions sin the equation editor, if sufficient memory is available. If a function is selected, its equals sign (=) is highlighted in the equation editor. If the function is deselected, then its equals sign is not highlighted. Only selected functions are plotted when the TI-8x plots a graph.

Important Functions

x	Pastes the variable x to the current cursor location
y	Pastes the variable y to the current cursor location
INSf	Inserts a deleted equation variable (function) name above the current cursor location (only the variable name is inserted)
DELf	Deletes the function that the cursor is on
SELECT	Changes the selection status of the function that the cursor is on (selects or deselects)
ALL+	Selects all defined function in the equation editor
ALL-	Deselects all defined function in the equation editor
STYLE	Assigns the next of seven available graph styles to the function that the cursor is on

3.1.1. Defining a Function

1. Display the equation editor.

2. If functions are stored in the equation editor, move the cursor down until a blank function is displayed.

3. Enter an equation in terms of x to define the function. When you enter the first character, the function is selected automatically. (The function's equals sign is highlighted.)

4. Move the cursor to the next function.

5. After entering the next function, change the style

GRAPH +F1

ENTER

ENTER

MORE + F3 (until a style is chosen)

One way to understand how each variable of a function effect the graph, change the variable, *m* and *c* in the equation $y = mx + b$. Try the following
y1=x
y2=2x
y3=x+1

3.2. Tables

The **TABLE** function on the TI-8x is a valuable tool used for analyzing functions. Students will find this tool irreplaceable once they have learned how to properly use it.

3.2.1. Displaying the Table

The table displays the independent values and corresponding dependent values for up to 99 selected function in the equation editor. Each dependent variable in he table represents a selected function stored in the equation editor for the current graphing mode. To display the equation editor, press GRAPH + F1.

TABLE Menu

TABLE	TBLST			

Enter into the equation editor **y1=x^2+3x-4** and **y2=sin (3x)**, then display the table by pressing TABLE + F1. You should get a screen that looks like the following:

X	yl	y2	
0	-4	0	
1	0	0.14112	
2	6	-0.279415	
3	14	0.4121185	
4	24	-536573	
5	36	0.6502878	
y2=-.5365291800046			
TBLST	SELCT	X	Y

3.2.2. Setting Up the Table

To display the table setup editor, select TBLST from the TABLE menu.

TblStart specifies the first independent variable values *x*.

ΔTbl (table step) specifies the increment or decrement from one independent variable value to the next independent variable in the table.

- If **ΔTBL** is positive, then the values of x increase as you scroll down the table
- If **ΔTBL** is negative, then the values of x decreas3 as you scroll down the table

Indpnt: Auto displays independent variable values automatically in the first column of the table, starting at **TblStrt**.

Indpnt: Ask displays an empty table, as you enter x values in the $x =$ prompt ($x =$ *value* **ENTER**), each value is added to the independent variable column and the corresponding dependent variable values are calculated and displayed. When **Ask** is set, you cannot scroll beyond the six independent variable values that are currently displayed in the table.

Glossary

Chord	Line joining two points on the circumference of a circle.
Circumference	Distance around a circle. Also known as the perimeter.
Co-domain	Output values of a number machine.
Composite functions	Combination of two functions used to create a new function.
Composition	Combination of two or more functions.
Congruency	Shapes that are exactly alike in all respects, including size, shape, and angle size.
Congruency statement	A statement used to note when two triangles are congruent.
Constant function	A function where element of the domain maps onto the same image.
Cyclic quadrilateral	A quadrilateral with endpoints that are on the circumference of a circle.
Decimal	Any fraction with a denominator of any power of 10.
Decimal fractions	See decimal.
Diameter	Any line that joins two points on a circle and passes through the center.
Domain	The input values of a number machine.
Error	The difference between the observed or recorded result and the correct one.
Exponent	See index.
Fraction	A number less than one.
Function	A special kind of relation in which each object is mapped onto only one image.
Gradient	The rate in which a relation or function increase or decreases.

Graph (linear)	A plot that rises or falls at a constant rate.
Graph (quadratic)	A graph that follows the relation of a constant by a term x2
Image set	The term used to describe when every element of the domain maps onto itself.
Index	See range.
Intercept (x)	Point where a graph intersects the x-axis.
Intercept (y)	Point where a graph intersects the y-axis.
Irrational number	A number that cannot be written as a fraction due to recurring decimals.
Lowest common denominator (LCD)	See common fractions.
Mapping	A relation in which for each object mapped there is only one image.
Ordered pair	A visual aid that represents a number machine.
Permutation	"The combination of domain and range in the form (domain, range)."
Radius	Distance from the center of a circle to any point on the circumference.
Range	The set of numbers onto which the domain is mapped. Also known as the image set.
Rational numbers	The y values of a function or the co-domain of a 1-1 or many to 1 mapping.
Recurring decimal	"A decimal that has one digit, or a group of digits, that is repeated endlessly."
Rounding off	A way of writing the number with fewer non-zero digits.
Self-inverse function	"If an element has an inverse under an operation, then the function is self-inverse."
Semi-circle	Half a circle. It is a shape formed by a diameter and an arc of a circle joining its endpoints.

Significant figures	The first figure digit (not zero) that you reach reading from left to right.
Similarity	Shapes that are alike through equal angles or sides or proportional in size.
Simultaneous equations	Two or more equations that have one or more solutions in common.
Standard form	A number that is written as a number between 1 and 10 and multiplied by a power of 10.

11 Appendices

B.V.I High School Mathematics Syllabus

COMPILED AND TYPED BY
GERMAINE V. SCATLIFFE
HEAD OF THE MATHEMATICS DEPARTMENT
B.V.I. HIGH SCHOOL

ADVICE, INPUT AND FEEDBACK FROM MEMBERS OF THE DEPARTMENT WAS WELCOMED IN THE REALIZATION OF THIS DOCUMENT.

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REVISED EDITION: SEPTEMBER 1998

CONTENT

SYLLABUSES IN MATHEMATICS FOR SECONDARY SCHOOLS

RATIONALE FOR THE MATHEMATICS SYLLABUSES

We live in a scientifically and technologically advancing world, for which mathematics is the nucleus of the cell from which these disciplines are developed, thus making it very important that students be well rounded in mathematical processes. Being mathematically literate would therefore give students the edge in acquiring one of the many careers or pursuing another discipline of which mathematics is the foundation or pre-requisite. Such careers are Accountants, Scientists, Computer Technicians, Bankers, Mathematics and Science Teachers just to name a few. Therefore it is imperative that Mathematics be taught in schools.

AIM OF THE SYLLABUSES

1. To develop in students the ability to think analytically.

2. To ensure that students are aware of the manipulation of numbers.

3. To provide students with necessary mathematical skills required to assist them in making every day life decisions and to function in the work place.

4. To prepare students for the use of mathematics in other disciplines and further studies.

OBJECTIVES OF THE SYLLABUSES

1. To help the student acquire a range of mathematical techniques and skills and to foster and maintain the awareness of the importance of accuracy.

2. To make Mathematics relevant to the interest and experience of the student, helping him to recognise Mathematics in his environment.

3. To cultivate the ability to apply mathematical knowledge to the solution of problems which are meaningful to the student as a citizen.

4. To cultivate the ability to think logically and critically.

5. To develop positive attitudes such as open-mindedness, self-reliance, persistence and spirit of enquiry.

6. To prepare students for the use of Mathematics in further studies.

7. To develop appreciation of the wide application of Mathematics and its influence in the advancement of civilisation.

8. To cultivate a growing awareness of the unifying structure of Mathematics.

LEVEL 10/11 MATHEMATICS

RECOMMENDED TEXT: Nelson Caribbean Mathematics Bk 1

SUPPLEMENTARY TEXT: Oxford Mathematics for the Caribbean Bk 1
Living Mathematics for the Caribbean Bk 1
ST(P) Caribbean Mathematics Bk 1

TOPICS

1. GEOMETRY
2. SETS
3. STATISTICS
4. COMPUTATIONS
5. NUMBER THEORY
6. CONSUMER ARITHMETIC
7. ALGEBRA
8. ORDER OF OPERATIONS
9. RATIO AND PROPORTION

UNIT 1. GEOMETRY

CONTENT: **Points, Lines, Angles, Triangles, Polygons, Solids.**

SPECIFIC LEARNING OBJECTIVES: **The student will be able to:**

1.1 Recall what is **Geometry**.

1.2 Define and represent a **point** and name a point using capital letters.

1.3 Define a **line** and describe a line using capital letters.

1.4 Draw and measure a straight line using a compass and ruler.

1.5 Define an **angle** and describe how it is formed.
- 1.5.1 Use capital letters to name angles
- 1.5.2 Draw and measure angles of any size

1.6 Classify angles according to size (acute, right, obtuse, straight, reflex, complete turn)

1.7 Define **Complementary** and **Supplementary Angles**.
- 1.7.1 Determine the complementary or supplementary angle to any given angle or set of angles.

1.8 State that **angles at a point** sum to 180° and find the missing angle to a set of angles at a point.

1.9 Define **Vertically Opposite Angles** and determine the missing angle for a pari of vertically opposite angles (use the concept of angles on a straight line to assist in determining the missing angle)

1.10 Describe a **triangle** and state the sum of the angles of a triangle is 180°.
- 1.10.1 Calculate the third angle of a triangle given the other two angles.

1.11 State the different types of triangles and list their properties (scalene, equilateral, isosceles, acute-angled, obtuse-angled, right-angled)

UNIT 2: SETS

CONTENT: **Definition and description of sets, elements of sets, union, intersection, Venn Diagrams.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Define a **set**.

2.2 Describe a set using
(a) **Words**
(b) **Loops**
(c) **Brackets**

2.3 State the meaning of the following terms and their symbols:
-Element of/member of ($\in$)
-Equal and equivalent sets
-Empty/Null sets ({} or $\varnothing$)
-Subset ($\subset$)
-Universal set ($\mathcal{U}$ or $\mathscr{E}$)
-Joint and disjoint sets
-Union of sets ($\cup$)
-Intersection of sets ($\cap$)
-Venn diagram
-Complement of a set (eg B′ reads B complement)
-Finite and infinite sets

2.4 Determine the intersection and union of two sets, whether joint or disjoint.

2.5 Name regions shaded in a Venn Diagram as well as shade regions on a Venn diagram.

2.6 List all the possible subsets of sets with up to three (3) members.

UNIT 3: STATISTICS

CONTENT: **Collect data, displaying information, averages.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 Define **Statistics** and state what is meant by **data.**

3.2 Collect information/data using tally tables.
- 3.2.1 Describe what is **tallying.**
- 3.2.2 Construct frequency tables from tally tables.
  - -Describe a **frequency table**.
- 3.2.3 Differentiate between a **score** and a **frequency**.

3.3 Display information using pictographs
- 3.3.1 Describe a **pictograph**
- 3.3.2 Design a pictograph with a title, body and a key/scale.
- 3.3.3 Determine the scales to be used when drawing pictographs.

3.4 Display information using a bar chart or bar graph.
- 3.4.1 Draw a bar graph using suitable scales.
- 3.4.2 Interpret a bar graph, (determine the mode)

3.5 State what is meant by **average.**
- 3.5.1 Compute the three averages: **mode, mean, and median.**

3.6 Use the Cartesian plane to represent information (First quadrant only)
 3.6.1 Define the following terms: coordinate, axis (pl. axes), x-axis, y-axis, x-coordinate, y-coordinate.
 3.6.2 State the relationship between coordinates and the components of an ordered pair.
 3.6.3 Show ordered pairs as coordinate points on the Cartesian plane.
 3.6.4 State the x or y coordinate of any point on the Cartesian plane.

UNIT 4: COMPUTATIONS

CONTENT: **Four rules with decimals and fractions (+, -, x, ÷)**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Add, Subtract, Multiply and Divide decimals.

4.2 Add Subtract, Multiply and Divide fractions.

UNIT 5: NUMBER THEORY

CONTENT: **Types of Numbers, multiple, factor, prime number, L.C.M., H.C.F., Number Bases.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Define the different types of numbers.
- -natural or counting numbers
- -whole numbers
- -rational or fractional numbers
- -integers (positive and negative)

5.2 Define and identify **odd** and **even numbers**.

5.3 Define and identify a **prime number**.

5.4 Define and identify a **multiple** and a **factor**.
- 5.4.1 Define and identify a **prime factor**.
- 5.4.2 Express a number as a product of its prime factors.
- 5.4.3 Find the H.C.F. and L.C.M. of numbers using prime factors.*
  Simple problems with [illegible]

5.5 Discuss number bases.
- 5.5.1 Define a **numeral** and list all the numeral for each base up to base ten.
- 5.5.2 Define **place value** and determine the place value of any numeral in any number up to base ten.
- 5.5.3 Convert from base ten to another base.
- 5.5.4 Convert from another base to base ten.

UNIT 6: CONSUMER ARITHMETIC

CONTENT: **Percentage, increasing and decreasing quantities, discount, profit, loss.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Recall what is a **per cent** and express a percentage as a fraction or a decimal and vice versa.

- 6.1.1 Find the percentage of a quantity.
- 6.1.2 Express one quantity as a percentage of another.
- 6.1.3 Use percentages to compare quantities.
- 6.1.4 Find the whole given a percentage of the whole.

6.2 Increase and decrease a given quantity by a percentage.

6.3 Determine the discount given on an article and hence the discounted price.

6.4 Define **profit** and **loss** and determine the profit or loss made on purchases or sales.

6.5 Solve problems in percentages (Include interest problems without applying the simple interest formulae).

UNIT 7: ALGEBRA

CONTENT: **Algebraic expressions, equations**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 State what is **Algebra**.

7.1.1 Define the following terms:

- **variable, constant, coefficient, term, algebraic expression, algebraic equation.**

7.2 Write algebraic expressions from statements.

7.3 Simplify simple algebraic expressions from statements.

7.4 Multiply and divide algebraic expressions.

7.5 Substitute values for variables

7.6 Write algebraic equations from statements

7.6.1 Solve simple algebraic equations.

7.6.2 Use algebraic equations to solve simple word problems.

UNIT 8: ORDER OF OPERATIONS

CONTENT: **Evaluate according to order of operations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 State the order of operations (BODMAS)

OPERATION	ORDER
Brackets	1^{st}
Multiply OR Divide	2^{nd} in the order they appear.
Add OR Subtract	3^{rd} in the order they appear.

8.2 Simplify expressions with three or more operations.

LEVEL 20 MATHEMATICS

RECOMMENDED TEXT: Nelson Caribbean Mathematics Bk 1
Living Mathematics for the Caribbean Bk 2

TOPICS

1. RATIO AND PROPORTION
2. MENSURATION
3. NEGATIVE NUMBERS
4. ALGEBRA
5. ARROW GRAPHS AND MAPPINGS
6. LINEAR GRAPHS
7. SETS
8. GEOMETRY
9. FRACTIONS
10. DECIMALS

UNIT 1: RATIO AND PROPORTION

CONTENT: **Sharing, direct and indirect proportion.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Recall what is a **ratio**

1.2 Write a ratio as a fraction, decimal, or percentage and vice versa.

1.3 Simplify a ratio.

1.4 Find the ratio of given amounts to each other.

1.5 Find equivalent ratios applying knowledge of equivalent fractions.

1.6 Divide or share a quantity in a given ratio or proportion.

1.7 Solve problems involving direct and indirect proportion using the unitary method only.

1.8 Solve problems involving ratio.

UNIT 2: MENSURATION

CONTENT: **Metric System, Length, Mass, Time, Perimeter, Area, Volume, Capacity.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Recall the units for length (metre)
- 2.1.1 Convert from one unit of length to another.

2.2 Recall the units for mass (gram)
- 2.2.1 Convert from one unit of mass to another.

2.3 Recall the units for time.
- 2.3.1 Convert from one unit of time to another.

2.4 Define **perimeter**.
- 2.4.1 Calculate the perimeter of any shape.
- 2.4.2 Determine the length of a side of a regular shape given the perimeter.

2.5 Define **area** and state the area in squared units.
- 2.5.1 Calculate the area of rectangles, triangles, and figures comprised of these shapes.
- 2.5.2 Find the length of a missing dimension given the area and the other dimensions.

2.6 Calculate the area of borders.

2.7 Describe a **parallelogram** and list its properties.
- 2.7.1 Calculate the perimeter and the area of a parallelogram.

2.8 Describe a **trapezium** and list its properties.
- 2.8.1 Show how the formulae for the area of a trapezium is derived by dividing the trapezium into two triangles.
- 2.8.2 Calculate the perimeter and area of a trapezium.

2.9 Define **volume** and give its measure in cubic units.

2.9.1 Calculate the volume of cubes and cuboids
(Volume = area of cross-section X length of prism)

2.10 Define **Capacity**

2.10.1 Recall the relationship between volume and capacity.

1 litre = 1000 cm^3
1 litre = 1000 ml
1 ml = 1 cm^3

2.10.2 Convert from one unit of volume or capacity to another.

UNIT 3: NEGATIVE NUMBERS

CONTENT: **Number line, negative and positive numbers.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 State what are integers

3.2 Show numbers on a number line

3.3 Identify a negative number by the '-' sign in front of it.

3.4 Determine the bigger or smaller of negative numbers as well as negative and positive numbers.

3.5 Show addition and subtraction of integers on a number line

3.6 Add and subtract integers without the use of a number line

3.6.1 Add a negative and a positive integer.

3.6.2 Add two negative integers.

3.7 Relate the concept of negative numbers to real life.

3.8 Multiply and divide directed numbers.

UNIT 4: ALGEBRA

CONTENT: **Multiplications and division of directed numbers, Simplifying algebraic expressions, indices, solving equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Remove brackets in algebraic expressions.

4.2 State what is an index and simplify expressions using indices.
- 4.2.1 Add the indices of like variables when multiplying
- 4.2.2 Subtract the indices of like variables when dividing.

– Substitution

4.3 Solve algebraic equations with one unknown
- 4.3.1 Solve equations with the variable on both sides.
- 4.3.2 Solve equations with brackets.
- 4.3.3 Solve equations with fractions.

4.4 Solve word problems algebraically.

UNIT 5: ARROW GRAPHS AND MAPPINGS

CONTENT: **Arrow graphs, mappings, Cartesian plane, graphs.**

SPECIFIC LEARNING OBJECTIVES: **The student will be able to:**

5.1 State what is an **arrow graph**.
- 5.1.1 Draw arrow graphs to show any given relationship between two sets.
- 5.1.2 Define and list the **domain, codomain, range, image set**, and the set of **ordered pairs** for any arrow graph.
  - Write the members of the domain and the image set from the set of ordered pairs.
- Draw the arrow graph from a set of ordered pairs.

5.2 State that an arrow graph becomes a mapping when each member of the domain has at least one image in the codomain.
- 5.2.1 Identify arrow graphs which are mappings.

5.3 Classify mappings by their types: 1-1, 1-M, M-1 and M-M.

5.4 Determine the rule for any given mapping from:
- (a) the graph
- (b) the ordered pairs.

5.5 Use the Cartesian plane to represent a mapping from a set of ordered pairs.
- 5.5.1 See the relationship between the components of an ordered pair and the x and y coordinates
- 5.5.2 Determine the x and y coordinate of any point on the Cartesian plane
- 5.5.3 State the mapping represented on the Cartesian plane.

UNIT 6: LINEAR GRAPHS

CONTENT: **Slope or gradient, y-intercept, x-intercept.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Draw linear relationships on a Cartesian plane from tables.

6.2 Determine whether a linear graph has a negative or a positive slope.

6.3 State the straight line equation **$y = mx + c$**

6.4 Determine the gradient of a straight line from the coefficient of the x term in the equation.

6.5 Determine the y-intercept of a straight line from the constant term 'c' in the straight line equation.

6.6 Determine the x-intercept of the line from the graph

6.7 Write linear equations in the standard form.

UNIT 7: SETS

CONTENT: **Set theory, number of elements in a set, problem solving.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Review terms used in set theory in form one.

7.2 Write the number of elements in a set using the notation
-n(name of set)

7.3 Solve problems involving two sets.

UNIT 8: GEOMETRY

CONTENT: **Angles, lines, angles on parallel lines**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Review **complementary, supplementary, vertically opposite angles** and **angles at a point.**

8.2 State what is an **exterior angle**

8.2.1 State that the exterior angle of a triangle is equal to the sum of the two interior opposite angles.

8.3 Bisect a line using a pair of compasses.

8.4 Bisect an angle using a pair of compasses.

8.5 Construct a 90° angle using ruler and compasses only.

8.5.1 Construct 45° angles from a 90° angle using compasses only.

8.6 Construct 60° angle using ruler and compasses only.

8.6.1 Construct 120°, 30°, and 15° angles from a 60° angle using compasses only.

8.7 Describe **parallel lines** and list their properties.

8.7.1 Define a **transversal** as a line crossing two or more parallel lines

8.8 Describe **alternate angles.**

8.8.1 State that alternate angles between non-parallel lines are not equal but alternate angles between parallel lines are equal.

8.9 Describe **co-interior angles.**

8.9.1 State that co-interior angles between parallel lines are supplementary.

8.10 Describe **corresponding angles**.
  8.10.1 State that corresponding angles on parallel lines are equal.

UNIT 9: FRACTIONS

CONTENT: **Types of fractions, equivalent fractions, factors, multiples, L.C.M., H.C.F., computation with fractions.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

9.1 Describe a fraction and identifies the parts of a fraction - numerator and denominator.

9.2 State the types of fractions - proper, improper, mixed.

9.3 Reduce fractions to their lowest terms.

9.4 Write improper fractions as mixed numbers and vice versa.

9.5 Recall what are equivalent fractions and determine equivalent fractions to any given fraction.

9.6 Recall what is a factor, multiple, prime number and prime factor.
  9.6.1 Identify the factors and multiples of any number.
  9.6.2 Express numbers as a product of their prime factors.
  9.6.3 Use the product of prime factors to determine the H.C.F. and L.C.M. of a group of numbers.

9.7 Write a set of fractions in ascending or descending order.

9.8 Determine the bigger of two fractions and by how much.

9.9 Add, subtract, multiply and divide fractions.

9.10 Find the whole given a fraction of the whole.

9.11 Solve problems involving fractions.

UNIT 10: DECIMALS

CONTENT: **Decimal fractions, addition, subtraction, multiplication, division, rounding off, conversion of a fraction to a decimal.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

10.1 Define a decimal fraction.
- 10.1.1 Express a fraction as a decimal fraction where possible.
- 10.1.2 Write a decimal fraction in expanded form.

10.2 Write a decimal as a fraction.

10.3 Write a fraction as a decimal fraction and hence as a decimal.

10.4 Determine the larger of two decimals and writes a set of decimals in order of size (descending or ascending).

10.5 Add, subtract multiply and divide decimals.
- 10.5.1 Multiply and divide decimals by powers of 10.

10.6 Round Off decimals to decimal places.

10.7 Convert a fraction to a decimal.
- 10.7.1 Recall what are non-terminating and recurring decimals and write such decimals.

10.8 Solve problems involving decimals.

LEVEL 21 MATHEMATICS

RECOMMENDED TEXT:	Nelson Caribbean Mathematics Bk 1 Oxford Mathematics for the Caribbean Bk 2
SUPPLEMENTARY TEXT:	Living Mathematics for the Caribbean Bk 1

TOPICS

1. RATIO AND PROPORTION
2. MEASUREMENT
3. NEGATIVE NUMBERS
4. ALGEBRA
5. MAPPINGS
6. SETS
7. GEOMETRY
8. BUSINESS ARITHMETIC
9. FRACTIONS
10. DECIMALS

UNIT 1: RATIO AND PROPORTION

CONTENT: Sharing, direct and indirect proportion.

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Recall what is a **ratio**

1.2 Write a ratio as a fraction, decimal, or percentage and vice versa.

1.3 Simplify a ratio.

1.4 Find the ratio of given amounts to each other.

1.5 Find equivalent ratios applying knowledge of equivalent fractions.

1.6 Divide or share a quantity in a given ratio or proportion.

1.7 Solve problems involving direct and indirect proportion using the unitary method only.

1.8 Solve problems involving ratio.

UNIT 2: MEASUREMENT

CONTENT: Imperial and metric systems, perimeter, area, 12 hour clock.

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Recall the two types of units - Imperial and SI Units.
- 2.1.1 Revise the SI Unit for length
- 2.1.2 Convert from one unit of length to another

2.2 Define **perimeter**
   2.2.1 Find the perimeter of any shape combined of squares, rectangles and triangles.

2.3 Write 12-hour clock times in 24-hour clock time and vice versa.

2.4 Calculate the area of squares, rectangles and triangles and shapes combined of the latter shapes.

2.5 Define and calculate **volume**.
   2.5.1 Give the units of volume as cubic units.
   2.5.2 Find the volume of cubes and cuboids.
   2.5.3 Solve simple problems involving volume of liquids, gases and everyday objects.

UNIT 3: NEGATIVE NUMBERS

CONTENT: **Number line, four rules (+, -, x, ÷)**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 Describe what is a number line.
   3.1.1 Show numbers on a number line.
   3.1.2 Show addition and subtraction on the number line.

3.2 Define a negative number and an integer.
   3.2.1 Show negative numbers on the number line.
   3.2.2 Show subtractions on the number line.
   3.2.3 Determine the bigger or smaller of directed numbers.
   3.2.4 Add a negative and a positive integer.
   3.2.5 Add two negative integers.

3.3 Relate the concept of negative numbers in real life situations.

3.4 Show negative coordinates on a Cartesian graph.

3.5 Multiply and divide negative numbers.

UNIT 4: ALGEBRA

CONTENT: **Algebraic expressions, simplification, algebraic equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Recall what is **algebra.**

4.2 Define the following terms: algebraic expression, term, variable, constant, coefficient.

4.3 Simplify simple algebraic expressions.

4.4 Write algebraic expressions from statements.

4.5 Solve simple algebraic equations.

UNIT 5: MAPPINGS

CONTENT: **Arrow graphs, mappings, ordered pairs, cartesian graphs.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Describe an arrow graph.

5.2 Define the following terms: **domain, co-domain, range, rule of a relation, image, image set.**

5.3 Draw arrow graphs defined by a given rule.

5.4 Determine the rule of an arrow graph.

5.5 Draw arrow graphs from number machines and vice versa.

5.6 State what is a mapping.
5.6.1 Determine the rule of a mapping in the form:
$n \to n + 3$ where $n \in$ Domain.

5.7 Express a value and its image as an ordered pair.
5.7.1 Write the set of ordered pairs for any mapping diagram.
5.7.2 Draw arrow graphs to show the mapping of two sets described by a set of ordered pairs.
5.7.3 Determine the missing component of an ordered pair given one component and the rule.

5.8 Show a mapping of one set into another on a graph with rectangular axes.
5.8.1 State the meaning of axis, axes and co-ordinates.
5.8.2 Realize the similarity of an ordered pair and a Cartesian co-ordinates.
5.8.3 Represent a mapping on rectangular axes.

5.9 Read information from graphs.

UNIT 6: SETS

CONTENT: **Description of a set, intersection, union, subsets, Venn Diagrams.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 State what is a **set**.

6.2 Describe a set using:
(a) Words
(b) Brackets
(c) Loops

6.3 Give the meaning of the following terms and symbols:
Union ($\cup$), Intersection ($\cap$), Subset ($\subset$), Universal set($\mathcal{U}$ or $\mathscr{E}$), Element or member of ($\in$), Empty or Null set ($\{\}$ or $\varnothing$), Venn Diagram, Complement of a set (ex: B').

6.4 Name sets using capital letters.

6.5 Determine the intersection and union of two intersecting or disjoint sets.

6.6 Recognise and shade regions in Venn Diagrams.

6.7 Use Venn Diagrams to find the L.C.M. and H.C.F. of two numbers.

6.8 List all the possible subsets of sets with up to three members.

UNIT 7: GEOMETRY

CONTENT: **Types of angles, complementary and supplementary angles, angles at a point, vertically opposite angles, parallel lines, interior and co-interior angles.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 State what is an **angle** and how it is formed.

7.2 Define and identify each type of angle: **acute, obtuse, reflex, straight, right**, and **complete turn.**

7.3 Measure angles using a protractor.

7.4 Draw angles using ruler and protractor.

7.5 State the relationships between angles:
- (a) **complementary angles**
- (b) **supplementary angles**
- (c) **angles at a point**
- (d) **vertically opposite angles**

7.6 Describe and give the properties of **parallel lines.**

7.6.1 State the relationships between angles on parallel lines.
- **alternate, corresponding, interior, co-interior angles.**

7.6.2 Describe what is a **transversal.**

UNIT 8: BUSINESS ARITHMETIC

CONTENT: **Percent, profit and loss, discount, interest.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Recall what is a percent and a percent fraction.

8.2 Write a fraction as a percent and vice versa.

8.3 Express one quantity as a percentage of another.

8.4 Find a percentage of a quantity.

8.5 Give the meaning of profit, loss cost price, and selling price.
- 8.5.1 Calculate the profit and loss of quantities.
- 8.5.2 Calculate the profit and loss percent.
- 8.5.3 Determine the selling price.

8.6 Give the meaning of discount and sale.
- 8.6.1 Calculate the discounts offered on items.
- 8.6.2 Calculate the sale price.

8.7 Use percentages in real life situations.
- 8.7.1 Determine the interest on loans and the total amount to be repaid.
- 8.7.2 Determine the interest on deposits or loans.
  (Do not teach the simple interest equation).

UNIT 9: FRACTIONS

CONTENT: **Types of fractions, equivalent fractions, factors, multiples, L.C.M., H.C.F., computation with fractions.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

9.1 State what is a fraction and identifies the parts of a fraction - numerator and denominator.

9.2 Define and identify the types of fractions - proper, improper, mixed.

9.3 Reduce fractions to their lowest terms.

9.4 Write improper fractions as mixed numbers and vice versa. .

9.5 Recall what are equivalent fractions and determine equivalent fractions to any given fraction.

9.6 Recall what is a factor, multiple, prime number and prime factor.
- 9.6.1 Identify the factors and multiples of any number.
- 9.6.2 Express numbers as a product of their prime factors.
- 9.6.3 Use the product of prime factors to determine the H.C.F. and L.C.M. of a group of numbers.

9.7 Write a set of fractions in ascending or descending order.

9.8 Determine the bigger of two fractions and by how much.

9.9 Add, subtract, multiply and divide fractions.

9.10 Find the whole given a fraction of the whole.

9.11 Solve problems involving fractions.

UNIT 10: DECIMALS

CONTENT: **Decimal fractions, addition, subtraction, multiplication, division, rounding off, conversion of a fraction to a decimal.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

10.1 Recall what is a decimal fraction.
- 10.1.1 Express a fraction as a decimal fraction where possible.
- 10.1.2 Write a decimal fraction in expanded form.

10.2 Write a decimal as a fraction.

10.3 Write a fraction as a decimal fraction and hence as a decimal.

10.4 Determine the larger of two decimals and writes a set of decimals in order of size (descending or ascending).

10.5 Add, subtract multiply and divide decimals.
- 10.5.1 Multiply and divide decimals by powers of 10.

10.6 Round Off decimals to decimal places.

10.7 Convert a fraction to a decimal.
- 10.7.1 State what are non-terminating and recurring decimals and write such decimals.

10.8 Solve problems involving decimals.

LEVEL 30 MATHEMATICS

RECOMMENDED TEXT: Living Mathematics for the Caribbean Bk 3

SUPPLEMENTARY TEXT: Nelson Caribbean Mathematics Bk 2

TOPICS

1. APPROXIMATION AND CALCULATIONS
2. CONSUMER ARITHMETIC
3. TRANSFORMATION
4. NEGATIVE NUMBERS AND ALGEBRA
5. TRIGONOMETRY
6. GEOMETRY
7. MENSURATION
8. LINEAR GRAPHS

UNIT 1: APPROXIMATION AND CALCULATIONS

CONTENT: **Rounding off, squares, square-root, Pythagoras' Theorem.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Round off numbers to
   - (a) the nearest place value
   - (b) decimal places
   - (c) significant places

1.2 Find the square of numbers giving your answer to three (3) significant figures.

1.3 Find the square root of numbers giving your answer to three (3) significant figures.

1.4 State Pythagoras' Theorem.
   - 1.4.1 Use Pythagoras' Theorem to prove if a triangle is right-angled.
   - 1.4.2 Use Pythagoras' Theorem to find the unknown side of a right-angled triangle.
   - 1.4.3 Solve problems involving Pythagoras' Theorem.

UNIT 2: CONSUMER ARITHMETIC

CONTENT: **Currency conversion, Cost price, selling price, profit and loss, profit and loss percent, interest, Income tax, hire purchase, insurance.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Convert from one currency to another.

2.2 Find the Cost Price given the Selling Price and the profit or loss percent.

2.2.1 Find the Selling Price given the Cost Price and the Profit or Loss.

2.2.2 Find the Loss or Profit Percent given the Cost Price and the Selling Price.

2.3 State the Simple Interest equation: **I = P x R x T**

2.3.1 Rearrange the formulae to find Principal, Rate, or Time.

2.4 Define **Income Tax**.

2.4.1 Recall what is taxable income, tax free allowance, net income.

2.4.2 Use tax and allowance tables to calculate income tax.

2.5 Define **Hire Purchase**.

2.5.1 Calculate the deposit and total installments

2.5.2 Calculate Hire Purchase Price :

HP Price = Deposit + total installments

2.6 Define **Insurance** and state how it works.

2.6.1 Calculate the premiums to be paid on the value of goods to be insured.

2.6.2 Calculate the rate of the insurance premium.

2.6.3 Calculate the value of the goods to be insured.

2.6.4 Calculate motor insurance premiums using tables of premiums and no claim bonus tables.

UNIT 3: TRANSFORMATION

CONTENT: **Symmetry, reflection, rotation, translation.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 Define **symmetrical** and **line of symmetry**.
- 3.1.1 Find the line of symmetry of shapes.

3.2 Define **reflection, mirror image** and **mirror line.**
- 3.2.1 Recall the properties of a reflection.
- 3.2.2 Find the coordinates of the points a shape maps onto, when it is reflected in a given line. (Use lines parallel to axes only)

3.3 Define **rotation, rotational symmetry** and **order of rotational symmetry.**
- 3.3.1 Rotate an object about a centre for angles of turns of 90^o, 180^0, 270^o. (¼, ½, ¾ turns)
- 3.3.2 Determine the order of rotational symmetry of any shape.

3.4 Form shapes from folded pieces of paper and identify lines of symmetry.

3.5 Define **Translation** and state its properties.
- 3.5.1 Describe a translation by a column vector.
- 3.5.2 Determine the image of a point after a translation.
- 3.5.3 Determine the translation between a point and its image.
- 3.5.4 Translate an object.

UNIT 4: NEGATIVE NUMBER AND ALGEBRA

CONTENT: **Directed Numbers, simplifying expressions, substitution, linear equations, simultaneous equations, brackets.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Review four rules with negative numbers (+, -, x, ÷)

4.2 Review simplifying expressions, removing brackets, substitution, multiplication and division of terms with indices..

4.3 Solve linear equations.

4.4 Solve simultaneous equations by
  (a) elimination method
  (b) substitution method

4.5 Calculate the product of two brackets.

4.6 Solve problems involving algebra
  (a) linear
  (b) simultaneous

UNIT 5: TRIGONOMETRY

CONTENT: **Sine, cosine, tangent.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 State the three trigonometrical ratios:

5.1.1 **Sine ratio:** $\textbf{Sin (angle)} = \dfrac{\textbf{opposite side}}{\textbf{hypotenuse}}$

5.1.2 **Cosine ratio:** $\textbf{Cos (angle)} = \dfrac{\textbf{adjacent side}}{\textbf{hypotenuse}}$

5.1.3 **Tangent ratio:** $\textbf{Tan (angle)} = \dfrac{\textbf{opposite side}}{\textbf{adjacent side}}$

5.2 Use Calculators to find the sine, cosine, and tangent of angles.

5.3 Use Calculators to find the angle for any given value of sine, cosine and tangent.

5.4 State that:
(a) $\sin x^\circ = \cos (90^\circ - x^\circ)$
(b) $\cos x^\circ = \sin (90^\circ - x^\circ)$

5.5 Use sine, cosine and tangent ratios to find lengths and angles in right-angled triangles.

5.6 Use trigonometrical ratios to solve problems
(Diagrams are required in solving problems)

UNIT 6: GEOMETRY

CONTENT: **Angle relations, angles, triangles.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Review complementary, supplementary, vertically opposite, alternate, corresponding , exterior angles and angles at a point.

6.2 Review drawing and bisecting lines using compasses.

6.3 Review drawing and bisecting angles using compasses.
6.3.1 Construct angles of 90°, 60°, 30°, 45°, 120°, 135° etc using compasses and ruler only.

6.4 Draw perpendicular from a point to a line.

6.5 Construct triangles given
(a) three sides
(b) two sides and the included angle
(c) two angles and the included side

6.6 Construct the circumscribed circle of a triangle (Bisect Lines)

6.7 Construct the inscribed circle of a triangle (Bisect angles)

UNIT 7: MENSURATION

CONTENT: **Area, perimeter and area of circles, volume.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Review area of irregular shapes, squares, rectangles, triangles, parallelograms, trapeziums.

7.1.1 Find the missing length of the above shapes given the other length(s) and area or perimeter.

7.2 Recall the parts of a circle (radius, diameter, chord, sector, segment, arc)

7.2.1 Show that the relationship between the circumference and the diameter is equal to π.

7.2.2 Recall that the diameter is twice the radius.

7.2.3 Calculate the circumference of a circle as:

$$\mathbf{C = 2\pi r} \quad \text{or} \quad \mathbf{C = \pi D}$$

7.2.4 Calculate the area of a circle as: $\mathbf{A = \pi r^2}$

7.2.5 Determine the radius or diameter of a circle given the circumference or area.

7.3 Calculate the volume of prisms including cylinders.

7.3.1 Find the area of cross-section of prisms or heights given the volume and other dimensions.

UNIT 8: LINEAR GRAPHS

CONTENT: **Coordinate, linear relations, linear graphs, gradient, y-intercept, x-intercept.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Plot and give the coordinates of any point of the four quadrants of the Cartesian plane.

8.2 Graph linear equations from a table of values or from three points.

8.3 State the equation of a straight line as $\mathbf{y = mx + c}$
- 8.3.1 Write linear equations in standard form.
- 8.3.2 Determine the gradient **(m)** from the equation
- 8.3.3 Determine the y-intercept **(c)** from the equation or calculations.

8.4 Calculate the x-intercept of a straight line by putting y=0 in the equation of the line.

8.5 Sketch the graph of a straight line from the x and y intercepts.

8.6 Determine whether lines have negative or positive slopes.

8.7 Determine if lines are parallel or perpendicular.

8.8 Calculate the gradient of a straight line
- (a) from the graph
- (b) by calculation $\quad \mathbf{m = \dfrac{vertical\ rise}{horizontal\ run}}$

8.9 Calculate the equation of a line given at least two points on the line.

8.10 Solve simultaneous equations graphically.

LEVEL 31 MATHEMATICS

RECOMMENDED TEXT: Oxford Mathematics For The Caribbean Bk 3

TOPICS

1. APPROXIMATION AND CALCULATIONS
2. CONSUMER ARITHMETIC
3. TRANSFORMATION
4. STATISTICS
5. NEGATIVE NUMBERS AND ALGEBRA
6. MENSURATION
7. COORDINATE GRAPHS
8. COMPUTATION

UNIT 1: APPROXIMATION AND CALCULATIONS

CONTENT: **Rounding off, squares, square-root, Pythagoras' Theorem.**

SPECIFIC LEARNING OBJECTIVES: **The student will be able to:**

1.1 Round off numbers to
- (a) the nearest place value
- (b) decimal places
- (c) significant places

1.2 Find the square of numbers giving your answer to three (3) significant figures.

1.3 Find the square root of numbers giving your answer to three (3) significant figures.

UNIT 2: CONSUMER ARITHMETIC

CONTENT: **Percentage, profit, loss, simple interest, hire purchase, currency conversion.**

SPECIFIC LEARNING OBJECTIVES: **The student will be able to:**

2.1 Review percentage.
- 2.1.1 Write a quantity as a percent.
- 2.1.2 Change a fraction to a percent and vice versa.
- 2.1.3 Calculate a percentage of a quantity.
- 2.1.4 Express one quantity as a percentage of another.

2.2 Calculate the profit and the profit %.

2.3 Calculate the loss and the loss %.

2.4 Calculate the simple interest on investments: **I = P x R x T**

2.5 Define Hire Purchase.
- 2.5.1 Calculate the deposit.
- 2.5.2 Calculate the total installments.
- 2.5.3 Calculate hire purchase price as:

  HP Price = Deposit + Total installments

2.6 Convert from one currency to another.

UNIT 3: TRANSFORMATION

CONTENT: **Symmetry, reflection, rotation.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 Define **symmetrical** and **line of symmetry**.
- 3.1.1 Find the line(s) of symmetry of shapes.

3.2 Define **reflection, mirror image** and **mirror line**.
- 3.2.1 State the properties of a reflection.
- 3.2.2 Find the coordinates of the points an object maps onto, when it is reflected in a given line. (Reflect only in lines parallel to axes)

3.3 Define **rotation, rotational symmetry** and **the order of rotational symmetry.**
- 3.3.1 Rotate an object about a centre for angles of turns 90°, 180° and 270° (¼, ½, ¾ turns).
- 3.3.2 Determine the order of rotational symmetry of any shape.

3.4 Form shapes from folded pieces of paper and identify lines of symmetry.

UNIT 4: STATISTICS

CONTENT: **Bar graphs, Pie Charts, Tally tables, averages.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Review Bar graphs.
 4.1.1 Interpret and draw Bar graphs.

4.2 Describe a Pie chart.
 4.2.1 Interpret Pie Charts.
 4.2.2 Find the value represented by $1°$.
 4.2.3 Find the angle represented in each sector.
 4.2.4 Draw Pie Charts.

4.3 State what is meant by tallying.
 4.3.1 Construct Tally tables and Frequency tables.

4.4 Determine the mean, mode and median of a set of data.

UNIT 5: NEGATIVE NUMBERS AND ALGEBRA

CONTENT: **Directed Numbers, simplifying expressions, linear equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Review addition, subtraction, multiplication and division of directed numbers with similar and different signs.

5.2 State the meaning of : variable, constant, coefficient, term, algebraic expression, equation, index.

5.3 Simplify algebraic expressions with
  (a) Brackets
  (b) Indices

5.4 Substitute values for letters to determine the value of an expression.

5.5 Solve simple linear equations **(No Fractions)**

5.6 Solve simple problems algebraically by writing the problem as an equation and solving.

UNIT 6: MENSURATION

CONTENT: Area, perimeter, parallelograms, trapeziums, circles.

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Review area and perimeter of rectangles, squares and triangles.

6.2 Describe a parallelogram and state its properties.
  6.2.1 Identify the base and the vertical height of a parallelogram.
  6.2.2 Calculate the area of a parallelogram.
  6.2.3 Find the missing dimension of a parallelogram given the area and the other dimension.

6.3 Describe a trapezium and state its properties.
  6.3.1 Find the area of a trapezium by
    (a) dividing the trapezium into two triangles
    (b) using the formulae: $\mathbf{A = \frac{1}{2}(a + b)h}$, where **a** and **b** are the parallel sides and **h** is the vertical height between the parallel sides.

6.4 Find the area of shapes combined of rectangles, squares, triangles, and trapeziums.

6.5 Recall the parts of a circle (radius, diameter, arc, circumference, sector, segment)
6.5.1 Find the circumference of a circle using: $\mathbf{C = 2\pi r}$ **or** $\mathbf{\pi D}$
6.5.2 Find the area of a circle using: $\mathbf{A = \pi r^2}$

6.6 Find the area of borders using any of the combined shapes taught in this unit.

6.7 Solve simple problems involving area and perimeter.

UNIT 7: COORDINATE GRAPHS

CONTENT: **Coordinates, axes, linear graphs.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Plot points with positive and negative coordinates (Four quadrants)

7.2 Read graphs.

7.3 Draw linear graphs from a table of values.
- Choose suitable scales
- Draw axes and label them correctly
- Plot points given the ordered pairs in the table
- Connect the points with a straight line

UNIT 8: COMPUTATION

CONTENT: **Fractions, decimals.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Review addition, subtraction, multiplication and division of fractions.
  - 8.1.1 Compute fractions with two different operations.
  - 8.1.2 Solve problems involving fractions with application to every day situations.

8.2 Review addition, subtraction, multiplication and division of decimals.

8.3 Convert a fraction to a decimal and vice versa.

LEVEL 40/50 MATHEMATICS

RECOMMENDED TEXT: Oxford Mathematics Bk 4

SUPPLEMENTARY TEXT: Living Mathematics For the Caribbean Bk 4

TOPICS

1. COMPUTATION AND NUMBERS
2. MAPPINGS AND FUNCTIONS
3. GRAPHS I
4. GEOMETRY
5. SETS
6. TRANSFORMATION
7. ALGEBRA
8. STATISTICS AND PROBABILITY
9. CONSUMER ARITHMETIC
10. VECTORS AND MATRICES
11. TRIGONOMETRY
12. GRAPHS II

UNIT 1: COMPUTATION AND NUMBERS [pg 35 - 47]

CONTENT: **Fractions, decimals, rounding off, indices, standard form, errors in measurements, number bases.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Review calculations with fractions (+, -, x, ÷)

1.2 Review calculations with decimals (+, -, x, ÷)

1.3 Convert a fraction to a decimal and vice versa.

1.4 Round off numbers to:
- (a) the nearest place value
- (b) number of decimal places
- (c) number of significant figures.

1.5 Review the following rules for indices
- (i) $a^n \times a^m = a^{n+m}$
- (ii) $a^n \div a^m = a^{n-m}$
- (iii) $a^0 = 1$
- (iv) $a^{-n} = {}^1/a^n$
- (v) $(a^n)^m = a^{n \times m}$
- (vi) $(a/b)^{-n} = (b/a)^n$
- ** (vii) $a^{m/n} = \sqrt[n]{a^m}$ or $(\sqrt[n]{a})^m$

1.6 Write numbers in standard form.

1.7 Identify errors in measuring (the greatest possible error)

1.8 Calculate and note the degree of accuracy.

1.9 Convert from one base to another.
1.9.1 Add and subtract in bases.

UNIT 2: MAPPINGS AND FUNCTIONS [pg 14 - 23 & 185 - 194]

CONTENT: **Arrow graphs, domain, co-domain, image set, ordered pairs, mappings, functions.**

SPECIFIC LEARNING OBJECTIVES: **The student will be able to:**

2.1 Define the following terms: mapping, domain, co-domain, range or image set, ordered pair.

2.2 Draw mapping diagrams defined by a given rule.
- 2.2.1 List the image set of a mapping.
- 2.2.2 List the set of ordered pairs represented in a mapping.

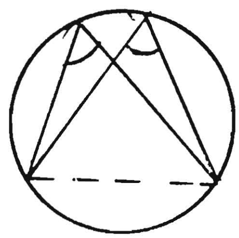
2.3 Determine the rule of a mapping.

2.4 Classify mappings as:
- (a) one - one
- (b) one - many
- (c) many - one
- (d) many - many

2.5 Define a function.
- 2.5.1 Determine when a mapping is a function.
- 2.5.2 Use function notation to describe a set:

  - **f: x→ x + 7** or **f(x) = x + 7**
- 2.5.3 Find the image of an element in the domain defined by any function.
- 2.5.4 Find the element in the domain for which a given image is given, defined by any function - (solve algebraically)
- 2.5.5 Identify the Identity Function.
- 2.5.6 Find the inverse of a function.
- 2.5.7 Compose functions.
- ** 2.5.8 Find the inverse of a composite function.

4.6 State that all angles at the circumference, standing on the same chord and in the same segment of a circle are equal.

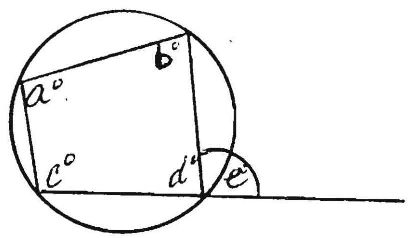


4.7 Define a cyclic quadrilateral.

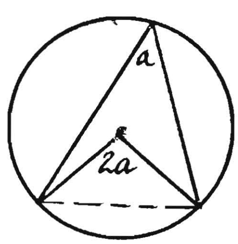
4.7.1 State that the sum of the opposite angles in a cyclic quadrilateral is 180°.

4.7.2 State that the interior angle opposite to an exterior angle are equal.

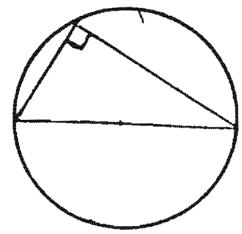
$a° + d° = 180°$
$c° + b° = 180°$
$a° = e°$



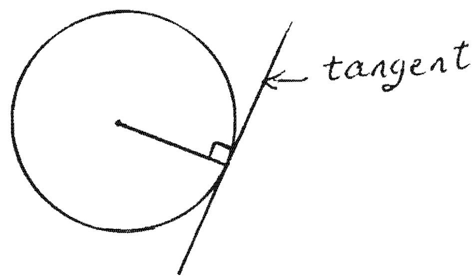
4.8 State that an angle at the centre of a circle is twice the size of the corresponding angle at the circumference standing on the same chord and in the same segment.



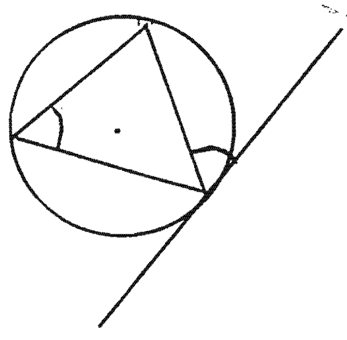
RB 4.9 State that an angle in a semi-circle is a right angle.



AC 4.10 Describe a tangent and state that the angle between a tangent and a radius is always 90°.



EA 4.11 State that the angle between a tangent and a chord is equal to the angle at the circumference, standing on the same chord.



UNIT 5: SETS

CONTENT: **Venn Diagram, subsets, union, intersection, De Morgan's Laws.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Review sets from lower forms.

5.2 Calculate the number of subsets of a set with **n** elements as $\mathbf{2^n}$.

5.3 State and apply De Morgan's Laws:
(a) $S' \cup T' = (S \cap T)'$
(b) $S' \cap T' = (S \cup T)'$

5.4 State and apply the fact: $\mathbf{n(A \cup B) = n(A) + n(B) - n(A \cap B)}$

5.5 Shade and recognise regions in three intersecting sets.
5.5.1 List members from regions in three intersecting sets.
5.5.2 Apply De Morgan's Laws to three intersecting sets.
(a) $A' \cup B' \cup C' = (A \cap B \cap C)'$
(b) $A' \cap B' \cap C' = (A \cup B \cup C)'$

5.6 Use the following to simplify set notations
(a) $A' \cap A = \varnothing$
(b) $A' \cup A = \mathscr{E}$
(c) $A \cap \mathscr{E} = A$
(d) $A \cap \varnothing = \varnothing$
(e) $A \cup \varnothing = A$

5.7 Solve problems in two and three intersecting sets.

UNIT 6: TRANSFORMATION

CONTENT: **Translation, reflection, rotation, enlargement.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Recall the properties of a translation
- 6.1.1 Describe a translation by a column vector.
- 6.1.2 Find the inverse of a vector.
- 6.1.3 Represent a translation vector graphically.
- 6.1.4 Find the image of an object given the translation vector.
- 6.1.5 Determine the translation vector given the object and its image.
- 6.1.6 Determine the object given the image and the translation vector.

6.2 Recall the properties of a rotation.
- 6.2.1 Describe a rotation by a centre and an angle.
- 6.2.2 Rotate an object given the centre and angle of turn.
- 6.2.3 Determine the centre and angle of turn of a rotation.
- 6.2.4 Determine if an object has rotational symmetry and give the order of rotational symmetry.

6.3 Recall the properties of a reflection.
- 6.3.1 Describe a reflection by a mirror line.
- 6.3.2 Reflect an object in a given mirror line.
- 6.3.3 Determine the mirror line of a reflection.
- 6.3.4 Determine if an object has reflective symmetry.

6.4 Recall the properties of an enlargement.
- 6.4.1 Describe an enlargement by a centre and a scale factor.
- 6.4.2 Enlarge an object.
- 6.4.3 Find the centre and scale factor of an enlargement.
- 6.4.4 Recognise the effect of a negative scale factor.
- 6.4.5 Calculate the area scale factor as $\mathbf{k^2}$ if the scale factor of the enlargement is **k**.
- 6.4.6 Calculate the volume scale factor as $\mathbf{k^3}$ if the scale factor of the enlargement is **k**.

6.5 Combine transformation.

UNIT 7: ALGEBRA

CONTENT: **Factorisation, quadratic equation, binary operations, linear equations, inequalities, simultaneous equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Compute directed numbers, simplifying expressions, and substitution.
7.1.1 Compute the product of two brackets.

7.2 Find the H.C.F. of a set of algebraic terms.

7.3 Factorise algebraic expressions
- common factors
- parts
- trinomials
- difference of two squares

7.4 Transform any formulae.

7.5 Factorise and solve quadratic equations.
- by factors
- by graphs
- ** by formulae

** 7.5.1 Complete the square of a quadratic expression.

7.6 Calculate fractions in Algebra.

7.7 Calculate the values of binary operations and determine whether they are commutative or associative.

7.8 Solve linear equations and word problems using linear equations.

7.9 State what is an inequality and solve linear inequalities.

7.10 Solve simultaneous equations.
** 7.10.1 Solve simultaneous equations one linear and one quadratic.

** 7.11 Solve problems involving linear, quadratic and simultaneous equations.

UNIT 8: STATISTICS AND PROBABILITY [pg 97-105, 265-276]

CONTENT: **Pie Chart, Bar graph, Histogram, Frequency polygon, averages, quartiles, percentiles, cumulative frequency curves, assumed mean.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Draw and interpret pie charts and bar graphs.

8.2 Differentiate between a bar graph and a histogram.

8.3 Draw histograms from a table of values.
- 8.3.1 Group data in class intervals.
- 8.3.2 Determine class boundaries and limits of class intervals.
- 8.3.3 Find the mid-interval value of an interval.
- 8.3.4 Construct from a histogram, by joining the mid-values of each class interval, a frequency polygon.

8.4 Construct a frequency polygon from a table of values.

8.5 Calculate the Mean, Mode, Median, Range, Lower and Upper Quartiles, Interquartile range and semi-interquartile range of a set of values.

** 8.6 Calculate the mean using an assumed mean.

8.7 Construct a cumulative frequency curve from a cumulative frequency table.

8.7.1 Determine the Median, Lower and Upper quartiles, interquartile range and semi-interquartile range and percentiles from cumulative frequency curves.

8.8 Discuss the idea of probability.

8.8.1 Describe the probability of an occurrence by anyumber between 0 and 1.

8.9 Find the probability of an event by performing an experiment.

8.9.1 Define the occurrence of a particular event as a success:

$$\mathbf{Pr(success)} = \frac{\textbf{number of successful outcomes}}{\textbf{total number of outcomes}}$$

8.10 Find the probability of an event (without performing an experiment - theoretical probability: $\mathbf{Pr(event)} = \frac{\textbf{number of successes}}{\textbf{total number of outcomes}}$

8.11 Use the idea of probability to real life situations.

** 8.12 Find the probability of compound events, mutually exclusive events, independent and dependent events.

8.12.1 Use tree diagrams to show all the possible outcomes.

UNIT 9: CONSUMER ARITHMETIC [pg 82 - 94]

CONTENT: **Ready reckoners, currency, cost price, profit and loss percent, simple and compound interest, depreciation, appreciation, hire purchase, mortgages, rates and taxes.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

9.1 Use ready reckoners.

9.2 Calculate bills.

9.3 Convert from one currency to another.

9.4 Calculate the cost price, selling price and loss percent.

9.5 Review simple interest.

9.6 Calculate the compound interest on an investment or loan for not more than three periods.

9.7 Calculate the appreciation and depreciation of an item for not more than three periods.

9.8 Calculate the hire purchase price, mortgages, rates and taxes.

UNIT 10: VECTORS AND MATRICES [pg 291 - 302, 340 - 352]

CONTENT: **Vector geometry, matrices, application.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

10.1 Use column vectors to describe a vector.

10.2 Add and subtract vectors.

10.3 Multiply a vector by a scalar.

10.4 State that:
- (a) Vectors addition is commutative.
- (b) Vector addition is associative
- (c) $\mathbf{a} + (-\mathbf{a}) = \mathbf{0}$ (null vector).
- (d) If **p** and **q** are shown by arrows of the same length and in the same direction then $\mathbf{p} = \mathbf{q}$.
- (e) If two arrows are parallel then one vector is a multiple of the other.
- (f) If **q** is the same length as **p** but in the opposite direction then $\mathbf{p} = -\mathbf{q}$.

10.5 Use vectors in geometry.
- 10.5.1 Write the position vector of any point.
- 10.5.2 Find the length of a vector.

10.6 Define a matrix as an array of numbers arranged in rows and columns.
- 10.6.1 Give the order of a matrix: (row by column).

10.7 Add and subtract matrices of the same order.

10.8 Multiply a matrix by (a) scalar and (b) a matrix.
- 10.8.1 State that matrix multiplication is not commutative but associative.

10.9 Determine the inverse of a 2 x 2 matrix.
    10.9.1 Find the determinant of a matrix.
    10.9.2 Recall that a matrix of determinant 0 is singular and has no inverse.

** 10.10 Solve simultaneous equations using matrices.

** 10.11 Use matrices in transformation [pg 352].

UNIT 11: TRIGONOMETRY [pg 228]

CONTENT: **Sine, cosine, tangent, sine rule, cosine rule, area of scalene triangles, radians.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

11.1 Recogise the tangent, sine and cosine curves.

11.2 State sine, cosine and tangent ratios.

11.3 Determine the Bearing of one object to another.
    11.3.1 Calculate the vertical and horizontal distances traveled after a one and two course journey.

11.4 Stat that:
- (a) $\tan 0° = 0$
- (b) $\tan 45° = 1$
- (c) $\tan 90° = \infty$
- (d) $\tan a° = \tan (180° + a°)$
- (e) $\sin 0° = 0$ and $\cos 0° = 1$
- (f) $\sin 90° = 1$ and $\cos 90° = 0$
- (g) $\sin a° = \sin (180° - a°)$
- (h) $\cos a° = \cos (360° - a°)$
- (i) $\sin^2 a + \cos^2 a = 1$

** 11.5 Find the sine, cosine and tangent of any angles between 90° and 360°. -(CAST)

** 11.6 Use the sine rule to find missing lengths and angles of scalene triangles

** 11.7 Use the cosine rule to find missing lengths and angles of scalene triangles.

** 11.8 Find the area of a triangle using:

(a) **A = ½ ab sin c** (where **a,b**, are two sides and **c** is the included angle between **a** and **b.**

(b) $\mathbf{A = \sqrt{s(s - a)(s - b)(s - c)}}$ (where **s** = ½ **(a + b + c**)

** 11.9 Change degrees to radians and vice versa. [pg 339]

UNIT 12: GRAPHS II [pg 201-205, 213-216, 306-311, 321-326]

CONTENT: **Lines and regions, linear programmingQuadratic graphs, maximum and minimum values of quadratic curves, gradients of curves.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

** 12.1 Construct tables of values for functions and plot their graphs.

** 12.2 Show regions on a graph defined by inequalities.
- 12.2.1 Find whether a point lies in a region described by an inequality or not.
- 12.2.2 Find the region described by two or more inequalities.

** 12.3 Describe a set of conditions using inequalities.
- 12.3.1 Represent these conditions as regions on a graph.
- 12.3.2 Use the graph to find solutions to everyday problems involving one or more conditions.
- 12.3.3 Use a line to show profit and how to find the maximum profit by drawing parallel lines.

** 12.4 Determine the maximum or minimum value of a quadratic graph.

** 12.5 Find the solution set for a quadratic inequality by using:
- (a) the factors
- (b) the number line
- (c) a graph

** 12.6 Find the gradients of curves.
- 12.6.1 Determine the rate of change from the gradient of the tangent at a particular point.

**** TO BE DONE BY GENERAL STUDENTS ONLY**

LEVEL 41/51 MATHEMATICS

RECOMMENDED TEXT: Basic Mathematics Revision and Practice

SUPPLEMENTARY TEXT: CXC Basic mathematics

TOPICS

1. APPROXIMATION AND PYTHAGORAS THEOREM
2. NUMBER THEORY AND COMPUTATION
3. GEOMETRY
4. NEGATIVE NUMBERS AND ALGEBRA
5. MENSURATION
6. CONSUMER ARITHMETIC I
7. SETS
8. GRAPHS
9. STATISTICS AND PROBABILITY
10. TRIGONOMETRY
11. CONSUMER ARITHMETIC II
12. TRANSFORMATION

UNIT 1: APPROXIMATION AND CALCULATIONS

CONTENT: **Rounding off, squares, square-root, Pythagoras' Theorem.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Round off numbers to
  (a) the nearest place value
  (b) decimal places
  (c) significant places

1.2 Find the square of numbers giving your answer to three (3) significant figures. (Using calculators)

1.3 Find the square root of numbers giving your answer to three (3) significant figures. (Using calculators)

1.4 State Pythagoras' Theorem.
  1.4.1 Use Pythagoras' Theorem to find the unknown side of a right-angled triangle.
  1.4.2 Solve problems involving Pythagoras' Theorem.

UNIT 2: NUMBER THEORY AND COMPUTATION

CONTENT: **Types of numbers, H.C.F. and L.C.M., fractions, decimals, ratio and proportion.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Define the following types of numbers: prime, square, whole, natural, integers.

2.2 Define a prime factor and express a number as a product of its prime factors. — factor tree/division

2.3 Calculate the H.C.F. and L.C.M. of two or more numbers using product of prime factors method.

2.4 Add, subtract, multiply and divide fractions.

2.5 Solve problems involving fractions.

2.6 Convert a fraction to a decimal and vice versa.

2.7 Add, subtract, multiply and divide decimals.

2.8 Solve problems involving decimals.

2.9 Simplify ratios.
- 2.9.1 Share a quantity in a given ratio or proportion.
- 2.9.2 Increase or decrease an amount by a given ratio.
- 2.9.3 Solve problems in direct and indirect proportion.

UNIT 3: GEOMETRY

CONTENT: Types of angles, relation of angles, triangles.

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 State the types of angles: acute, obtuse, reflex, right, straight, complete turn, complementary and supplementary angles. angles at a point, triangle V.O. angles.

use algebraic method

3.2 State the relationships between angles.
- 3.2.1 Define parallel lines and state their properties.
- 3.2.2 Identify the following relations: vertically opposite angles, corresponding angles, alternate angles, co-interior angles.

3.3 Define the types of triangles and state their properties.
- acute angled, right angled, obtuse angled, scalene.

Test ?

3.3.1 Recall that the exterior angle of a triangle is equal to the sum of the two opposite interior angles.

3.4 Bisect lines and angles using compasses and ruler.

3.4.1 Construct angles of 90°, 45°, 22 ½° , 120°, 60°, 30°, 15°, 75°, and 135° using compasses and ruler only.

3.5 Construct triangles given:
(a) three sides
(b) two sides and the included angle
(c) two angles and the included side

UNIT 4: NEGATIVE NUMBERS AND ALGEBRA

CONTENT: **Simplifying expressions, substitution, indices, linear equations, simultaneous equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Add, subtract, multiply and divide directed numbers.

4.2 Simplify algebraic expressions.

4.2.1 Remove brackets.

4.3 Substitute numbers for letters to determine the value of an expression.

4.4 Multiply and divide terms with indices.

4.5 Solve simple linear equations.

4.6 Solve simultaneous equations by the elimination method.

4.7 Solve problems algebraically.

UNIT 5: MENSURATION

CONTENT: **Perimeter, area, volume.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Calculate the perimeter of any shape.

5.2 Calculate the area of squares, rectangles, triangles, parallelograms, trapeziums and irregular shapes.

5.3 Calculate the circumference and area of a circle.
5.3.1 Calculate arc lengths and area of sectors.

5.4 Calculate the volume of prisms.

5.5 Solve problems involving area and volume.

UNIT 6: CONSUMER ARITHMETIC I

CONTENT: **Percentages, discount, commission, simple and compound interest, hire purchase, profit and loss.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Write a percentage as (a) a fraction
(b) a decimal } and vice versa.
6.1.1 Calculate percentages of quantities.
6.1.2 Express one quantity as a percentage of another.
6.1.3 Solve problems in percentages.
6.1.4 find the whole

NO CALCULATORS!

NELSON CARIBBEAN 2
CXC BASIC MATHEMATICS | GREER + LAYNE

REF

6.3
~~6.2~~ Calculate discounts. vok INCLUDE CALCULATORS.

6.4
~~6.3~~ Calculate commissions. vok

NO CALCULATORS

WEEK 2

6.4 Calculate simple interest using the formulae, and the rearranged formula. $I = \frac{PRT}{100}$ CANCELLING

6.5 Calculate compound interest for no more than three periods.
6.5.1 Use ready reckoners to compute compound interest.

6.6 Calculate the depreciation and depreciation of items for no more than three periods.

Oct 19, 1998

6.7 Calculate the Hire Purchase price on an item.

6.8 Calculate the percent profit or loss., cost price, selling price

UNIT 7: SETS

CONTENT: **Set notation, types of sets, subsets, complement, Venn Diagrams.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Describe sets using (a) words
(b) brackets
(c) loops

7.2 List the members of a set.

7.3 Identify equal and equivalent sets.

7.4 Identify an empty set.

7.5 Determine the number of members in a set.

7.5.1 Use the notation **n(A)** - number of members in set A.

7.6 Identify finite and infinite sets.

7.7 List all the possible subsets of a set with up to four members.

7.7.1 Calculate the number of subsets of a set with **n** members as $\mathbf{2^n}$

7.8 Determine the complement of a set.

7.8.1 Use the notation **A′** to mean **the complement of set A.**

7.9 Determine the Union and Intersection of two sets.

7.10 Construct and use Venn Diagram to show: subsets, complements, intersection and union of two sets.

7.11 Solve problems involving two sets.

UNIT 8: LINEAR GRAPHS 3

CONTENT: Coordinates, gradient, y-intercept, plotting graphs.

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Give the coordinate of a and plot points in a four quadrant graph.

8.2 Draw linear graphs from a table of three or more values.

8.3 State the straight line equation: $\mathbf{y = mx + c}$.

8.3.1 Determine the slope and y-intercept from the equation of a line.

8.3.2 Determine if the slope is negative or positive.

8.3.3 Determine if lines are parallel.

UNIT 9: STATISTICS Next topic:

CONTENT: **Averages, frequency table, bar graph, pie chart.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

9.1 Calculate the mean, mode and median of a set of data.
from bar chart

9.2 Construct a simple frequency table from a set of data.

9.3 Calculate the mean from a frequency distribution.

9.4 Draw and interpret bar graphs and pie charts.

UNIT 10: TRIGONOMETRY

CONTENT: **Sine, cosine, and tangent ratios.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

10.1 State the three trigonometrical ratios:

(a) $\text{Sin (angle)} = \dfrac{\text{opposite side}}{\text{hypotenuse}}$

(b) $\text{Cos (angle)} = \dfrac{\text{adjacent side}}{\text{hypotenuse}}$

(c) $\text{Tan (angle)} = \dfrac{\text{opposite side}}{\text{adjacent side}}$

10.2 Find the sine, cosine and tangent of angles.

10.3 Find the angle of any given sine, cosine or tangent ratio.

10.3.1 Finding angle of elevation/depression

10.4 Find the missing angles and lengths of right-angled triangles sing the trigonometrical ratios.

10.5 Solve problems using the trigonometrical ratios.

UNIT 11: CONSUMER ARITHMETIC II

CONTENT: **Wages, salaries, bills, currency conversion, taxes.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

11.1 Calculate wages and salaries.
 11.1 Determine overtime rates and wages.

11.2 Calculate ~~gas~~ phone and electricity bills.

11.3 Convert from one currency to another. (Use the unitary method)

11.4 Calculate income tax given the tax rates.

tax rate %

UNIT 12: TRANSFORMATION

CONTENT: **Translation, reflection, rotation, enlargement.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

12.1 State the properties of a translation
- 12.1.1 Describe a translation by a column vector.
- 12.1.2 Find the inverse of a vector.
- 12.1.3 Represent a translation vector graphically.
- 12.1.4 Find the image of an object given the translation vector.
- 12.1.5 Determine the translation vector given the object and its image.
- 12.1.6 Determine the object given the image and the translation vector.

12.2 State the properties of a rotation.
- 12.2.1 Describe a rotation by a centre and an angle.
- 12.2.2 Rotate an object given the centre and angle of turn.

12.3 State the properties of a reflection.
- 12.3.1 Describe a reflection by a mirror line.
- 12.3.2 Reflect an object in a given mirror line.

12.4 State the properties of an enlargement.
- 12.4.1 Describe an enlargement by a centre and a scale factor.
- 12.4.2 Enlarge an object.
- 12.4.3 Find the centre and scale factor of an enlargement.

ADDITIONAL TOPICS TO BE COVERED BY BASIC LEVEL 51 CLASS

(From Level 40/50 syllabus)

1. MAPPING AND FUNCTIONS
2. STANDARD FORM AND NUMBER BASES
3. ANGLES IN A CIRCLE
4. CUMULATIVE FREQUENCY GRAPHS
5. INEQUALITIES AND BINARY OPERATIONS
6. QUADRATIC GRAPHS AND VARIATION
7. BEARINGS

ARITHMETIC SYLLABUS

TOPICS

1. APPROXIMATION AND CALCULATIONS
2. NUMBER THEORY AND COMPUTATION
3. GEOMETRY
4. NEGATIVE NUMBERS
5. ALGEBRA
6. MENSURATION
7. CONSUMER ARITHMETIC
8. SETS
9. STATISTICS

UNIT 1: APPROXIMATION AND CALCULATIONS

CONTENT: **Rounding off, squares, square-root, Pythagoras' Theorem.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

1.1 Round off numbers to
  (a) the nearest place value
  (b) decimal places
  (c) significant places

1.2 Find the square of numbers giving your answer to three (3) significant figures. (Using calculators)

1.3 Find the square root of numbers giving your answer to three (3) significant figures. (Using calculators)

1.4 State Pythagoras' Theorem.
  1.4.1 Use Pythagoras' Theorem to find the unknown side of a right-angled triangle.
  1.4.2 Solve problems involving Pythagoras' Theorem.

UNIT 2: NUMBER THEORY AND COMPUTATION

CONTENT: **Types of numbers, H.C.F. and L.C.M., fractions, decimals, ratio and proportion.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

2.1 Define the following types of numbers: prime, square, whole, natural, integers.

2.2 Define a prime factor and express a number as a product of its prime factors.

2.3 Calculate the H.C.F. and L.C.M. of two or more numbers using product of prime factors method.

2.4 Add, subtract, multiply and divide fractions.

2.5 Solve problems involving fractions.

2.6 Convert a fraction to a decimal and vice versa.

2.7 Add, subtract, multiply and divide decimals.

2.8 Solve problems involving decimals.

2.9 Simplify ratios.
2.9.1 Share a quantity in a given ratio or proportion.
2.9.2 Increase or decrease an amount by a given ratio.
2.9.3 Solve problems in direct and indirect proportion.

UNIT 3: GEOMETRY

CONTENT: **Types of angles, relation of angles, triangles.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

3.1 State the types of angles: acute, obtuse, reflex, right, straight, complete turn, complementary and supplementary angles.

3.2 State the relationships between angles.
3.2.1 Define parallel lines and state their properties.
3.2.2 Identify the following relations: vertically opposite angles, corresponding angles, alternate angles, co-interior angles.

3.3 Define the types of triangles and state their properties.
- acute angled, right angled, obtuse angled, scalene.
3.3.1 Recall that the exterior angle of a triangle is equal to the sum of the two opposite interior angles.

3.4 Bisect lines and angles using compasses and ruler.
3.4.1 Construct angles of 90°, 45°, 22 ½° , 120°, 60°, 30°, 15°, 75°, and 135° using compasses and ruler only.

3.5 Construct triangles given: (a) three sides
(b) two sides and the included angle
(c) two angles and the included side

UNIT 4: NEGATIVE NUMBERS

CONTENT: **Number line, four rules (+, -, x, ÷)**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

4.1 Describe a number line.
4.1.1 Show numbers on a number line.
4.1.2 Show addition and subtraction on the number line.

4.2 Define a negative number and an integer.
4.2.1 Show negative numbers on the number line.
4.2.2 Show subtractions on the number line.
4.2.3 Determine the bigger or smaller of directed numbers.
4.2.4 Add a negative and a positive integer.
4.2.5 Add two negative integers.

UNIT 5: ALGEBRA

CONTENT: **Simplifying expressions, substitution, indices, linear equations.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

5.1 Simplify algebraic expressions.
 5.1.1 Remove brackets.

5.2 Substitute numbers for letters to determine the value of an expression.

5.3 Multiply and divide terms with indices.

5.4 Solve simple linear equations.

UNIT 6: MENSURATION

CONTENT: **Perimeter, area, volume.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

6.1 Calculate the perimeter of any shape.

6.2 Calculate the area of squares, rectangles, triangles, parallelograms, and irregular shapes.

6.3 Calculate the volume of regular prisms whose faces are squares, rectangles, parallelograms and triangles .

GRADING SYSTEM

PERCENTAGE	LETTER GRADE	QUALITY POINTS
85 - 100	A+	9
75 - 84	A	8
70 - 74	B+	7
65 - 69	B	6
60 - 64	C+	5
50 - 59	C	4
45 - 49	D+	3
40 - 44	D	2
35 - 39	E	1
0 - 34	F	0

(1) Letter grade for a pass in a course is C.

(2) Quality points needed for subject passes on High School Leaving Certificate and honour rolls.

Pass	4	-	5.9
Credit	6.0	-	7.9
Distinction	8	-	9

(3) Students with an average of 7 quality points qualify for the Chief Education Officer's Honour Roll and the Certificate of Excellence.

(4) Students with an average of 6 quality points will qualify for the school's Certificate of Merit.

Always give a helping hand,
A word of love, a smile
To help the soul beside you walk
Across each weary mile.

Kate Watkins Furman

UNIT 7: CONSUMER ARITHMETIC

CONTENT: **Percentages, discount, commission, simple interest, hire purchase, profit and loss, wages, salaries, bills, currency conversion.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

7.1 Write a percentage as (a) a fraction
(b) a decimal

7.1.1 Calculate percentages of quantities.
7.1.2 Express one quantity as a percentage of another.
7.1.3 Solve problems in percentages.

7.2 Calculate discounts.

7.3 Calculate commissions.

7.4 Calculate simple interest using the formulae.

7.5 Calculate the Hire Purchase price on an item.

7.6 Calculate the percent profit or loss.

7.7 Calculate wages and salaries.

7.7.1 Calculate overtime rates and wages.

7.8 Calculate gas and electricity bills.

7.9 Convert from one currency to another.

UNIT 8: SETS

CONTENT: **Set notation, types of sets, subsets, complement, Venn Diagrams.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

8.1 Describe sets using
 (a) words
 (b) brackets
 (c) loops

8.2 List the members of a set.

8.3 Identify equal and equivalent sets.

8.4 Identify an empty set.

8.5 Determine the number of members in a set.
 8.5.1 Use the notation **n(A)** - number of members in set A.

8.6 Identify finite and infinite sets.

8.7 List all the possible subsets of a set with up to four members.
 8.7.1 Calculate the number of subsets of a set with **n** members as $\mathbf{2^n}$

8.8 Determine the complement of a set.
 8.8.1 Use the notation **A′** to mean **the complement of set A.**

8.9 Determine the Union and Intersection of two sets.

8.10 Construct and use Venn Diagram to show: subsets, complements, intersection and union of two sets.

UNIT 9: STATISTICS

CONTENT: **Averages, frequency table, bar graph, pie chart.**

SPECIFIC LEARNING OBJECTIVES: The student will be able to:

9.1 Calculate the mean, mode and median of a set of data.

9.2 Construct a simple frequency table from a set of data.

9.3 Draw and interpret bar graphs and pie charts.

B.V.I High School
Student Handbook

B.V.I. HIGH SCHOOL

VIGILATE

STUDENTS HANDBOOK

PRINCIPAL'S REMARKS

I wish to congratulate you on the successful completion of your primary education, and to wish you every success as you embark on the secondary phase here at the British Virgin Islands High School.

If you are to be successful in your studies, it is very important that you use your time wisely. "Wise Use of Time" means:

(1) Not wasting time set aside for instruction while at school

(2) Reviewing work done at school nightly.

(3) Completing assignments on time.

(4) Reading ahead.

(5) Using ALL resources around you to gain information.

Education is not just learning academic subjects. It also involves learning to live with others; displaying respect for others as well as yourself.

Finally, if at this time you don't know what you would like to be, start looking around and asking questions. What kind of jobs are available now and/or will be opening "x" number of years from now? What are/will be the entry level (basic) requirements for these jobs? Am I strong in that subject area (for example Mathematics and Science for medicine)? The Guidance Officer can assist you in identifying your area of interest in relation to your ability.

Our endeavour is to help you to "Be the Best that you can be."

E. Stoutt

Elmore Stoutt

HISTORY OF THE SCHOOL

The BVI High School was officially opened on Friday September 27, 1968, by Mr. William Bell, Head of the British Development Division in Barbados. At the Ceremony Mrs. Margaret L. Bell unveiled a plaque set in a wall at the Administrative Block, in the presence of his Honour, the Administrator and Mrs. J.S. Thompson, the Chief Minister and his wife, Mr. & Mrs. H. Lavity Stoutt, Members of the Executive and Legislative Councils, Government Officials, guests from Puerto Rico and the U.S. Virgin Islands, parents, friends, staff and pupils of the school.

This school is an amalgamation of the Virgin Islands Secondary School established on May 3, 1943, and the Post Primary Department of the primary schools in the territory. The enrollment reached 783 during the first term.

In accordance with Regulation 7 of the Education Regulations, a High School committee was set up with effect from February 1969, for a term of two years to carry out the following functions:

1. to advise the principal on any matters connected with the management, discipline and general interest of the school.

2. to perform all such duties and exercise such powers which were vested in them by the Education Regulations.

Courses Offered

For the first two years there was a common core of subjects according to the ability of students. The 3rd, 4th and 5th year students were arranged according to three main courses: Academic, Commercial and Technical.

The following subjects were taught: Bible Knowledge, English Language, English Literature, History, Geography, Latin, Spanish, Mathematics (including New Maths), Physics, Chemistry, Biology, Woodwork, Metal Work, Home Economics (including catering), Typewriting, Shorthand, Elements of Commerce, Auto Mechanics, Electricity and Electronics.

Examinations

Some students worked towards G.C.E. "A" and "O" Levels. Others prepared for R.S.A and L.C.C. examinations, while others prepared for a local examination certificate which was taken after completing their course of studies.

Staff

The staff comprised of Mr. P. Carlise Scott as principal, 36 academic staff members and one (1) Office Manager and Secretary.

UPDATE ON THE HISTORY OF THE SCHOOL

The school's population is now 1,175.

Examinations offered are:	CXC, Royal School of Music and R.S.A.
Courses offered are:	Arts, Science, Accounts Information Technology, Typing, Home Economics, electricity, Auto Mechanics and Metal Works

The staff consists of:

Staff:	Academic	90
	Office	4
	Librarians	2
	Nurses	2
	Janitorial	6

Don't be a quitter; you're not alone -
we all must crawl before we're grown.
There are no rainbows without rain -
there are no victories without pain.

Clay Harrison

SCHOOL SONG

I would be true
For there are those who trust me
I would be pure for there and those who care
I would be strong for there is much to suffer
I would be brave for there is much to dare.

I would be friend
Of all the foe the friendless
I would be giving and forget the gift
I would be humble for I know my weakness
I would look up and laugh and love and lift
I would look up and laugh and love and lift.

SCHOOL COLOURS

NAVY BLUE - LIGHT BLUE - AND GOLD

SCHOOL MOTTO

VIGILATE

SCHOOL HOUSES

House	Name	Colour
1	Lettsome	Green
2	Lincoln	Blue
3	Flemming	Red
4	Carlisle	Gold

UNIFORM

The school uniform is to be strictly adhered to our **you will be sent home**. Prepare your uniform ahead of time instead of making excuses.

(A) BOYS - Light blue short sleeve shirt
Navy blue slacks (**not dungarees**)
Black belt
Navy blue or black or gray socks
Black or navy sneakers
Black or navy shoes

(B) GIRLS - Light blue,short sleeve blouse shirt style
Navy blue **knife-pleated** skirt from the waist). Waistband should be no wider than 2 inches with a blue or black button.
Skirt length - knee length or longer
White socks (no coloured designs acceptable)
Black or navy shoes
Black or navy sneakers

(C) A watch may be worn by all students and girls are permitted to wear **a small pair** of earrings (1 earring per ear).

(D) Physical Education - <u>Boys and Girls</u>
White T-shirt
White or navy blue short pants
White socks
White sneakers

(E) Technical - Overalls or aprons (boys)

(F) Food and Nutrition Lab - hair net, white apron (one with a bib)

(G) Clothing and Textiles - A sewing kit containing the following: 1 pair of paper scissors, 1 pair of dressmaker's scissors, 1 tape measure, tracing wheel, 1 packet sewing needles, tailor's chalk, 1 packet machine needles and 1 packet dress maker's pins.

NOTE: Students will not be accepted in class without full uniform unless permission is sought in writing by parents.

INSURANCE

Parents are encouraged to secure accident insurance coverage for their children. The policy is available at $15.00 for twenty-four (24) hours coverage (including vacation).

Forms will be available from the school's guidance office on the first day of the new school year.

"If unaware of our ignorance,
we'll be misled by our knowledge"

ATTENDANCE

The school week runs for six (6) days unlike a normal calendar week. In this way, the school year is not interrupted by holidays and breaks. Each week is organised as follows:

DAY 1	GENERAL ASSEMBLY	8:40 - 9:00
DAY 3	FORM ASSEMBLY	8:40 - 9:00
DAY 2,4,5	HOMEROOM ASSEMBLY	8:40 - 9:00
DAY 6	HOUSE ASSEMBLY	8:40 - 9:00

TEACHING PERIODS

PERIOD 1	9:00 - 9:40
PERIOD 2	9:40 - 10:40
BREAK	10:20 - 10:35
PERIOD 3	10:35 - 11:15
PERIOD 4	11:15 - 11:55
LUNCH	11:55 - 12:55
REGISTRATION	12:55 - 1:10
PERIOD 5	1:10 - 1:50
PERIOD 6	1:50 - 2:30
PERIOD 7	2:30 - 3:15

I can do all things through Christ
who strengthens me.

Philippians 4:13

TEXTBOOK

The first year at the High School, begins with Form One. At this point, students are made familiar with the campus, teachers, class-rooms, school rules and regulations. During the first few days a time-table and a list of the required text-books issued to the students.

These textbooks are not issued to the students and have to be purchased from the school's book-room. The prices and names of books will be stated. Parents should be given this book list and preferably should purchase the books themselves.

As the student progresses to higher Forms they will need other books, particularly Maths and English.

Two exercise books for each subject is a must. Binder leaves are used primarily for tests and the writing of reports.

SCHOOL DEPARTMENTS

The departments within the school are as follows:

DEPARTMENT	HEAD
Art and P.E.	Mrs. T. Forbes
Business	Ms. E. George
Geography	Mrs. B. Turnbull
History and R.E.	Ms. C. George
Home Economics	Mrs. M. Kupoluyi
Language	Mrs. J. Vanterpool
Mathematics	Mrs. J. Stoutt
Music	Mrs. R. Vanterpool
Science	Mr. H. Hatchette
Spanish	Mrs. T. Gordon
Technical	Mr. J. Vanterpool

Punctual and regular attendance is required of all students. The school day begins at **8:40 a.m.**

The attendance register is marked by the homeroom teacher. A student who desires to leave school before the end of the day should bring a note from his or her parent requesting permission to leave at a specific hour. A pass slip will then be issued.

As soon as the bell rings in the morning, each student is to report to his/her homeroom, where attendance will be taken. The second ringing of the bell indicates that it is time to attend the assembly scheduled for that day.

When the bell rings in the afternoon, students must report directly to their homeroom for attendance to be taken. After assembly in the morning and after the second bell in the afternoon, students should proceed immediately to the classroom of their next subject teacher.

After each class period, unless the student is supposed to remain in a particular class for more than one period, students are required to proceed ***hastily*** and ***quietly*** to their next subject teacher.

If a student is to be absent from school on a particular occasion, he/she should get a note signed by his/her parents to take to his/her homeroom teacher, explaining the reason for such absence.

HOMEROOM TEACHERS AND ACTIVITIES

Each class is assigned a homeroom teacher who supervises the homeroom activities and assists with other activities for the entire academic school year. The homeroom period is especially valuable as it gives an opportunity for the development of good teacher-student relationships. The students can have informal chats with the teacher to sort out problems and discuss issues.

YEAR HEADS

Special year heads are assigned to each form group; whose main duties include that of Pastoral Guidance.

FORM	HEAD
1	Mrs. C. Kettle
2	Mrs. G. Scatliffe
3	Mrs. A. Russell
4	Mrs. J. Rhymer
5	Miss L. A. Turnbull

THE SCHOOL LIBRARY

All students of the school should become a member of the Library. There is no fee involved. It is open Monday to Friday 8:40 - 4:15. The Library is open to students at certain times during the day, under supervision, and also after school.

A maximum of two books may be borrowed for a time period of two weeks before they are returned or renewed. Books overdue will carry no fine, but the students will be warned not to allow their books to become overdue

In addition, a student will not receive his/her report at the end of term until all outstanding books are returned or paid for. Students must pay for all books which they lose.

HEALTH SERVICES

Health services are provided, free for all students. The students contact the nurse who gives passes and makes appointments. The students must see the nurse before visiting the doctor or dentist, except in emergencies.

Dental appointments are scheduled for Wednesday and Friday mornings. The doctor sees patients daily, Monday to Friday inclusive. Dental treatment continues during the vacation. During that time students contact the staff of the Dental Surgery.

On special occasions, Medical Personnel visit the school to give service on the spot or lecture to the students.

A School Nurse is stationed next to the Sick Bay. She deals with any emergency or injuries that take place while at school. If you become ill while at home, please have your parents take you to a doctor or the clinic. Injuries sustained during a weekend should be treated accordingly. If you become ill while at school, see the School Nurse. ***Do not go into the Sick Bay unless you have been instructed by the School Nurse to do so.***

Parents must accompany their sons and daughters in order for them to be seen by the doctor.

Parents should ensure that their children have breakfast before leaving for school.

Wisdom consists of the anticipation
of consequences.

Norman Cousins

Guidelines on "How to Study"

1. Find a quiet area where you will not be disturbed, where there are no distractions. For example, a corner in a room; under a tree etc. can be your special 'study spot'.
2. It is important that you be relaxed when studying. Your level of concentration should be high so that you will understand and retain most of what you have studied. Whether it be early morning/evening or late evening; if then is your 'ideal time', make use of it.
3. All form one students should spend at least one hour studying.

   Forms 2 & 3 - 2 hours

   Forms 4 & 5 - 2 hours or more

   This does not include the time you spend completing homework assignments or class projects.
4. To find out if you really understand what you are studying, have someone (parent, relative) listen to you while you go over what you studied. If you can talk about it, you can write about it.
5. If there is no one to listen to you, try to recall the information you studied. If you cannot recall the information, then that area should be restudied.

   'Always use a dictionary to check the meaning of unfamiliar words'.

The real purpose of books is to trap
the mind into doing its own thinking.

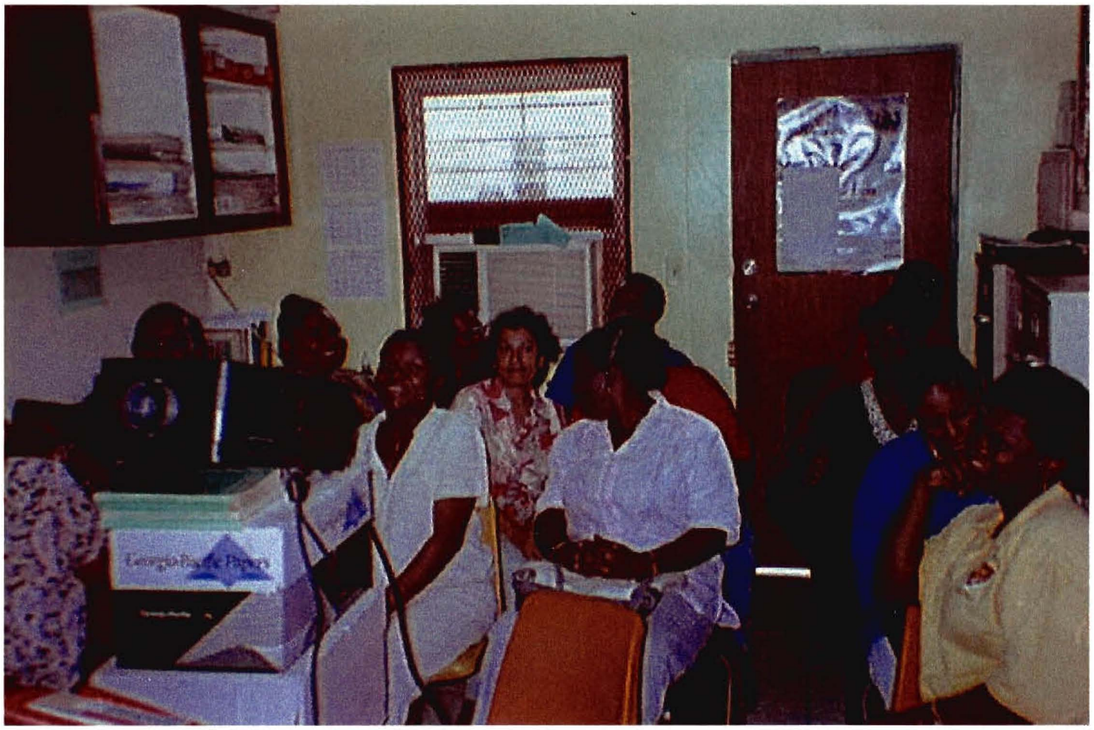
Christopher Morley

HELPFUL TIPS "WHAT TO DO IF"

1. You are sick: Notify the nearest teacher.
2. You need to go to the hospital: ask a teacher or someone to notify the General Office.
3. You need to use the telephone: you may use the pay phone by the General Office. If the pay phone is not working ask the secretary for permission to use the phone in the office. All calls are 25 cents.
4. You need to contact parent or guardian: go to the General Office and see the Secretary.
5. You want to leave the campus: obtain a pass from the Assistant Principal.
6. You need to see the Principal: go to the General Office and talk to the Secretary.
7. You have a problem: see your Homeroom Teacher, Year Head, Assistant Principal, Principal or Guidance Officer.
8. You have a personal problem: see the Guidance Officer first.
9. You need to purchase textbooks: go to the bookroom at the hours listed: 10:20 - 10:35; 12:30 - 12:50.
10. You need to leave class: the teacher in charge must grant your permission.

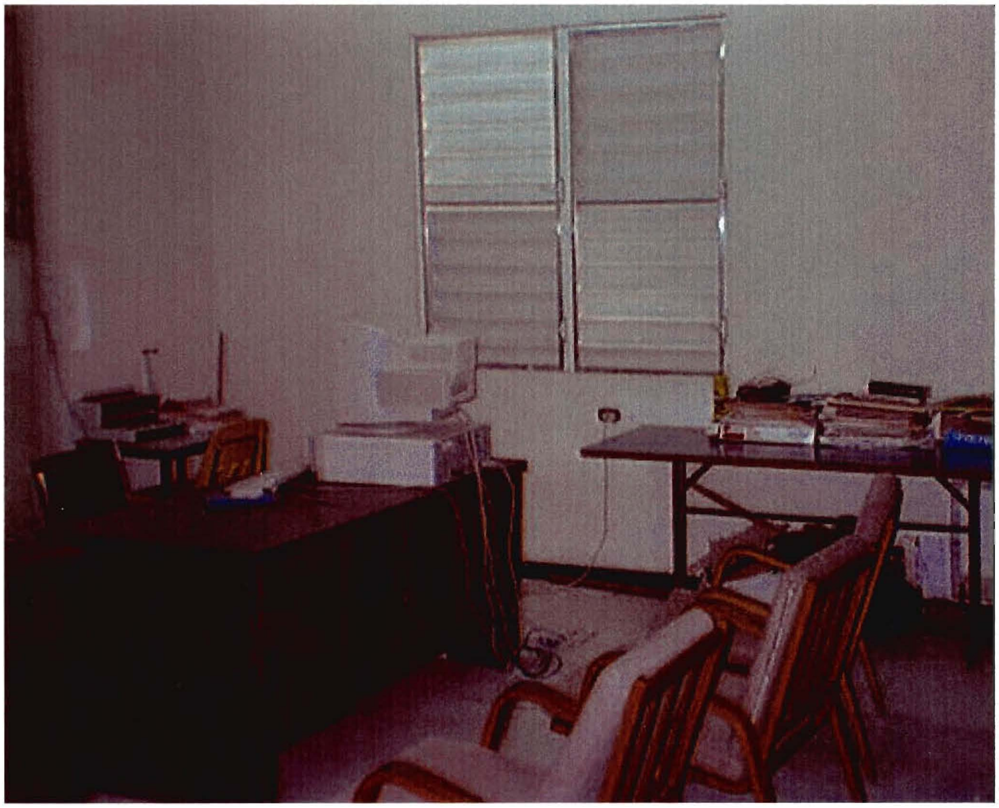
A good angle to approach any problem
is the try - angle.

Photographs of the B.V.I High School



Members of the math department at first general meeting

The only non-West Indian teacher



Our office

Main office Student records

D – block primarily math classrooms

Security at main entrance

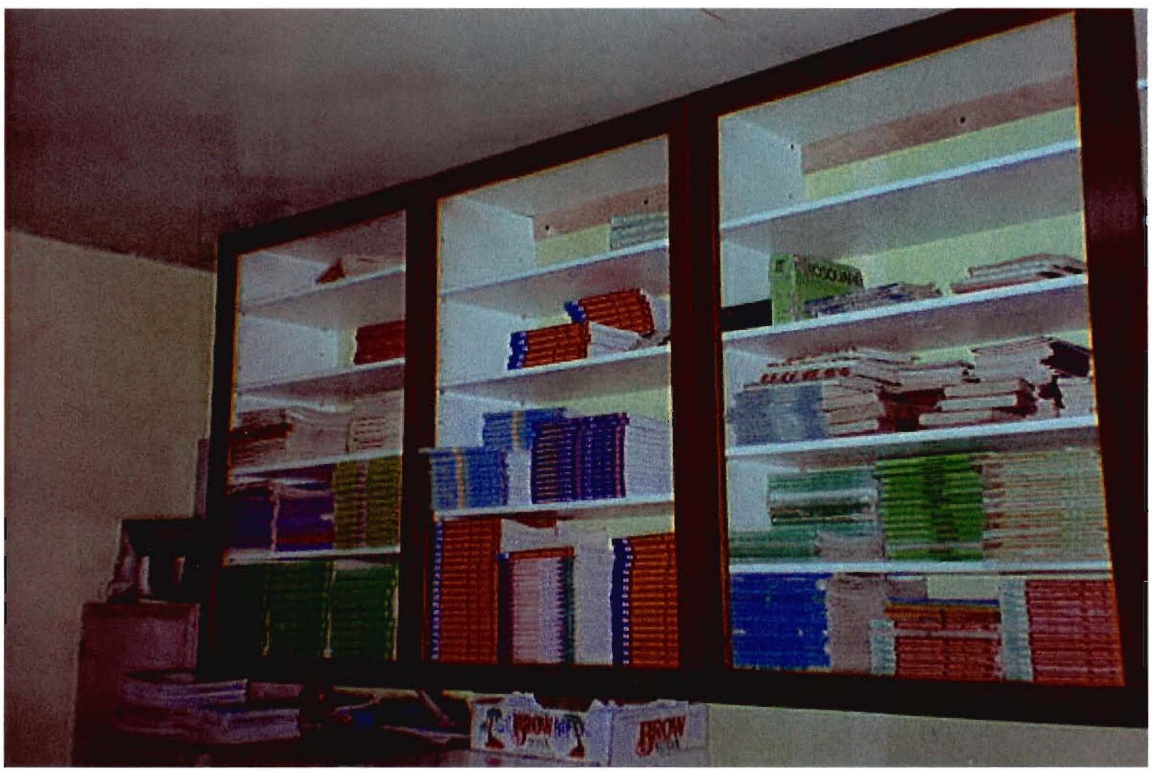
A mural of the schools *standards*

Math office

Ms. Mathavious the School librarian

Reference section of school library - possible future iqp

School library



Math books which students can borrow in the math department.

The view from one of our many apartments

Assessment tests of upper level students

Technology Educated Students

Assessment tests of upper level students

Control Group of Students