Uniquely designed to restore your faith
in learning mathematics

Summary

In "The Mathematical Genius in You",
Edzai C. Zvobwo reveals the timeless, necessary and
sufficient secrets to success in mathematics.
His methods are simple and straight forward
and can be effectively used by anyone who wants
to excel in mathematics. He motivates
and educates such that you will surely
discover the mathematical
genius within you that is yearning to
be exposed. He proves that you
only need to learn and understand the
habit of solving problems to
attain success!

"Mathematics is to the mind, what love is to the heart."
- from THE MATHEMATICAL GENIUS IN YOU.

MathsGenius
Helping you make it!

Website: www.mathsgenius.co.za Email: info@mathsgenius.co.za

email SABC EDUCATION at socialmedia@sabc.co.za or
visit www.sabceducation.co.za .

THE MATHEMATICAL GENIUS IN YOU

THE MATHEMATICAL GENIUS IN YOU

Sponsored By:
SABC EDUCATION

EDZAI C. ZVOBWO

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SABC Education and Mathematics

SABC Education assists young children, youth and young adults with mathematical challenges by delivering compelling content and outreach activities to audiences via programmes such as **Rivoningo** and **Geleza Nathi.**

Danie Swart, Head of SABC Education

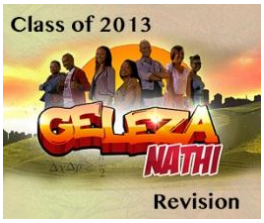
Rivoningo targets small children including grades R – 3, caregivers, parents and teachers while **Geleza Nathi** targets grade 10 - 12 learners.

Rivoningo is for anyone with an interest in early childhood development and foundation phase education. The show helps children with numeracy lessons and supports the development of skills. Numeracy skills are needed to deal with general learning issues outside day to day classroom situations which influence what happens in classrooms.

There is a segment for parents and caregivers where experts share ideas that parents and caregivers can do with their children**. Robots Lelo** and **Keke** share fun activities with children in a spacious studio with beautiful appealing colours. Presenters **Kuli** and **Vele** guide the children through number fun songs as they learn the similarities and differences between numbers.

Early Childhood Development (ECD) is the most important period of a child's learning; if a solid foundation is established during this time, a child can develop capabilities and achieve a good background knowledge which serves as a cornerstone for development in the future. Quality foundation-phase education is critical for grades R to 3 to develop numeracy skills. In **Rivoningo**, children learn the importance of numeracy.

Rivoningo promotes simplicity and adherence from basic fundamental principles to explicit teachings of numbering in a traditional way. The programme creates a balance between traditional education and modern approaches which favours progressive education. **Rivoningo** has a web presence through its domain name, www.sabceducation.co.za/rivoningo and gather its feedback using e-mail address- rivoningo@sabc.co.za.



Geleza Nathi hosts some of South Africa's best teachers who make learning fun and fresh, they brighten brains early in the morning to prepare learners for the school day ahead. **Geleza Nathi** delivers core curriculum concepts to grade 10 -

12 learners and gets them equipped with knowledge to ace their exams at the end of the year. The show brings cool back to school by providing sound advice and promoting positive attitudes. The show has a tutoring service on facebook where learners can ask questions and interact directly with teachers.

Geleza Nathi goes on whirlwind national tours, visiting various high schools across all nine provinces. During the tour a different school is featured and our young, funky presenters get the scoop on what's happening at various schools and communities countrywide. **Geleza Nathi** brings mathematics to lounges where viewers can test their knowledge.

Each year when the final countdown to the matric finals begin, **Geleza Nathi** gives learners the opportunity to revise everything they need to know moments before they step into exam venues. Top teachers to go through typically challenging questions to help learners with any last minute preparation they might need.

Prior to the name **Geleza Nathi** the show was called **Matrics Uploaded**. The team produced DVDs that cover content that supports the grade 10 to 12 curricula. The DVDs offer lessons across subjects; Accounting, Business Studies, English, Life Sciences, Mathematics, Mathematical Literacy and Physical Sciences. Printable worksheets are on the DVDs to support the lessons. To purchase copies of Balance It! Dot It! Write & Read It! Live It! Calculate It! Count & Calculate It! and Discover It! contact: content@sabc.co.za or 011 714 8066.

Geleza Nathi is popular on the internet under the domain name www.sabceducation.co.za/gelezanathi. This domain features all content from Matrics Uploaded and will soon upgrade to www.gelezanathi.tv - org and com. The e-mail used to gather feedback is gelezanathi@sabc.co.za.

Established in 1996, **SABC Education** is an SABC business unit responsible for delivering the educational mandate of the public broadcaster. In true South African social tradition, **SABC Education's** content, gathered from a wide range of educational issues contributes to a rich cultural shared South African identity.

Using radio, television, web, print, outreach, telephones, cell phones and other new media platforms, **SABC Education's** programming and services reach most South Africans.

SABC Education's programming covers issues in the following categories:

Formal Education - Programming that supports the accredited curriculum from reception year to tertiary for learners and educators targeting the foundation, intermediate, senior, FET (Further Education and Training), higher and ABET (Adult Basic Education and Training) education phases.

Tweens & Youth Development - Programming for young people that is non-curriculum and informal and promotes involvement in personal empowerment, community development and society's well-being. Tweens defined as 8 – 12 years old, the development stage which recognises the uniqueness of being between a child and a teenager and/or youth. Youth defined as 13 – 25 years old. Youth is a transition period characterised by youthful energy, enthusiasm, ambition and creativity.

Public Information & Social Development - Programming that plays a key role in building democracy, non-curriculum programmes for the nation that are informal, provide information, skills and knowledge through social action campaigns and strengthen sustainable development for individuals, families and communities.

For comments and suggestions, e-mail us at socialmedia@sabc.co.za or visit our website at www.sabceducation.co.za.

ABOUT THE AUTHOR

Edzai is a high achieving business analyst/IT project manager and Game Mathematician with experience in:

- Software development operations in a mobile banking and payments environment (eWallets, switches, EMV, online and real-time payment processing, settlement and reconciliation).
- Calculating, verifying mathematical and statistical models and software for the gaming industry.
- Teaching mathematics, mathematical literacy and statistics at tertiary and high school level.
- Giving maths motivational talks and training programs for youth to reach their potential.
- Training educators and parents to recognise and unleash the genius in their learners and children.
- Presenting and teaching mathematics on television.

He possesses a BSc Honours in Applied Mathematics, Diploma in Business Analysis and Certificate in Data Analysis. Has a good understanding of the Software Development Life Cycle and the value of keeping projects on time and within budget and meeting client requirements. Has a great appreciation of methodologies of succeeding in the studying and applying mathematics in real world situations i.e. Simulation, forecasting, quantitative decision-making, optimisation, mathematical modelling, project management, random number generators etc.

He has a passion for mathematics; this is evidenced by his motivational works across schools in South Africa. He has participated in intervention programmes in the townships through workshops and camps assisting struggling learners. He called himself The Mathematical Evangelist on a Mindset TV programme. A lot of MBA students from leading institutions of higher learning have benefited from his tutoring of research methods and statistics. His dream is to demystify mathematics and ensure that learners become good problem solvers.

Edzai is a firm believer of the theory that Africa can be liberated if her people are mathematically literate and apply the problem solving thinking methodology to find solutions to social, political and economic problems that have long hounded the “Mother-Continent”. Good problem solvers will eradicate poverty in Africa. To become a good problem solver, one needs to be mathematically trained to achieve this.

ACKNOWLEDGEMENTS

This project has been made possible as a result of teamwork. There are too many people to mention, but special mention goes to Tinashe Chimbwanda my sidekick whom I have bounced off many ideas and Patricia Mareya for urging me on.

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A special thanks to SABC TV Content General Manager, Ms. Pontsho Makhetha for granting us space to engage with SABC Education to produce this publication.

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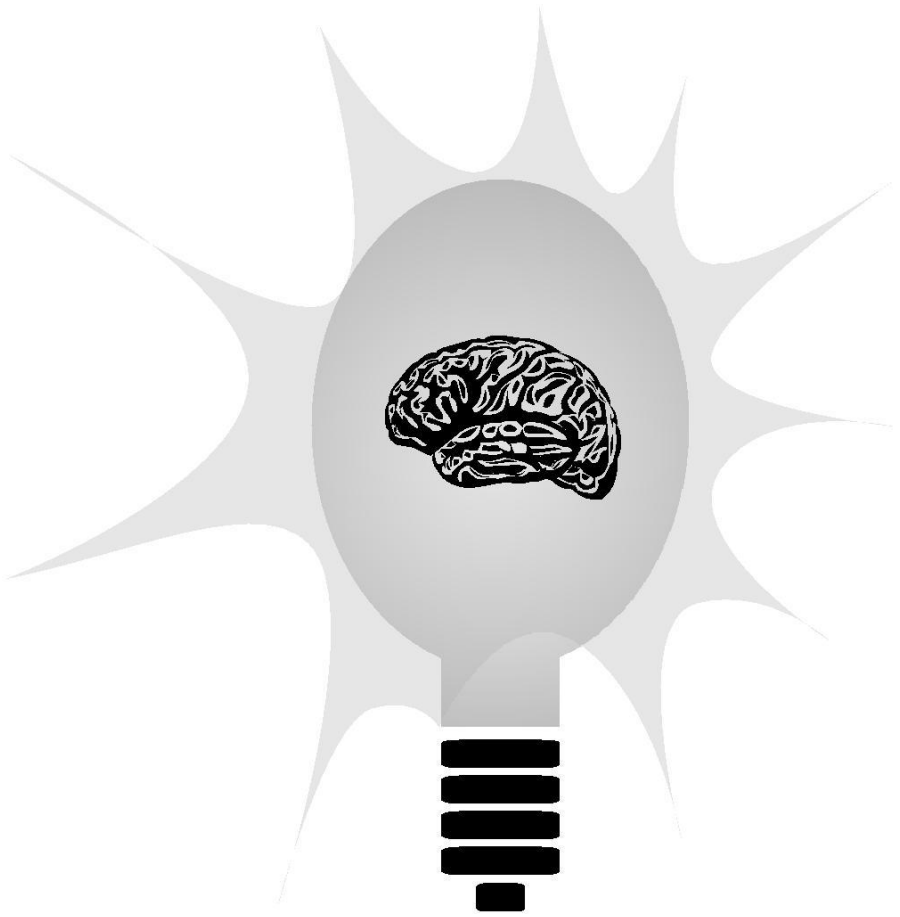

THE AIMS OF THIS BOOK

This book has been written with you in mind! It is a personal and candid dialogue on how to succeed in MATHEMATICS.

Its objective is to motivate, educate and in the process expose the correct mind-set, attitude and attributes necessary to excel in mathematics.

The book seeks to demystify mathematics as a learning area then give tips on how to become a good ***'problem solver'*** regardless of varying mathematical abilities. It has been written for those who:

- Have given up on mathematics, so that they can rekindle the lost love.
- Would like to ignite passion for mathematics that never existed before.
- Think they have average mathematical ability but wish to climb the mathematical ladder and push towards excellence.
- Have already found the secret to success and perhaps do not realise this thus should be encouraged to 'stay on top'.

At the formative level this book seeks to produce problem solvers and logical beings that are versatile in the workplace and life in general.

The principles exposed in this book can be applied to other learning areas and it is hoped that after reading this book you should able to know where you stand mathematically and then work to improve your status. You can be the maths genius you have secretly always wanted to be.

If you are a parent you will be shown the attributes and attitudes to emphasize to your children so as to optimize their mathematical potential.

For teachers, this book is handy in the motivation of students to adopt a positive attitude towards math.

The ultimate aim is for learners to be able to fully acquire math knowledge and skills, combine logical and intuitive reasoning and communicate effectively on interpretations in context to the real world using appropriate mathematical language and notations.

Use this book in conjunction with your textbooks and mathematical happiness will follow. Once you know how to think like a mathematician then victory and success is yours.

Go for it, go for gold. I know you can push yourself to be the best you can be.

HOW TO USE THIS BOOK

This book is divided into three parts:

Part 1: Chapters 1 – 6

1. Help you identify the reasons why you should study mathematics and the benefits that will be gained.
2. Guide you through a self-evaluation test where you locate yourself in terms of attitude towards mathematics.
3. Compare your attributes and attitudes with those of acclaimed mathematicians.
4. Motivate and challenge you on how you can shift your mindset and prepare for success.

Part 2: Chapters 7 – 10

This part should be read in conjunction with a textbook so as to apply the suggested principles and techniques on real questions.

These chapters:

1. Give tips and enhance problem solving skills.
2. Illustrate logical thinking and how this is developed.
3. Emphasize the need for effective communication between examiner and learner in answering questions.
4. Encourage the use of strategy games and puzzles as a means of stimulating logical thinking.

Part 3: Chapters 11 – 12

1. Expose phi (1.618…) as one of the most fascinating numbers.
2. Display mathematics as a discipline that cuts across the spectrum of life.
3. The Conclusion.
4. A Glossary to clarify technical words.

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CHAPTER ONE

WHY STUDY MATHEMATICS?

"Pure mathematics is, in its way, the poetry of logical ideas."
– **Albert Einstein**, German (1879 – 1955)
Developed the special and general theories of relativity, Nobel Prize for Physics in 1921.

Chapter Overview

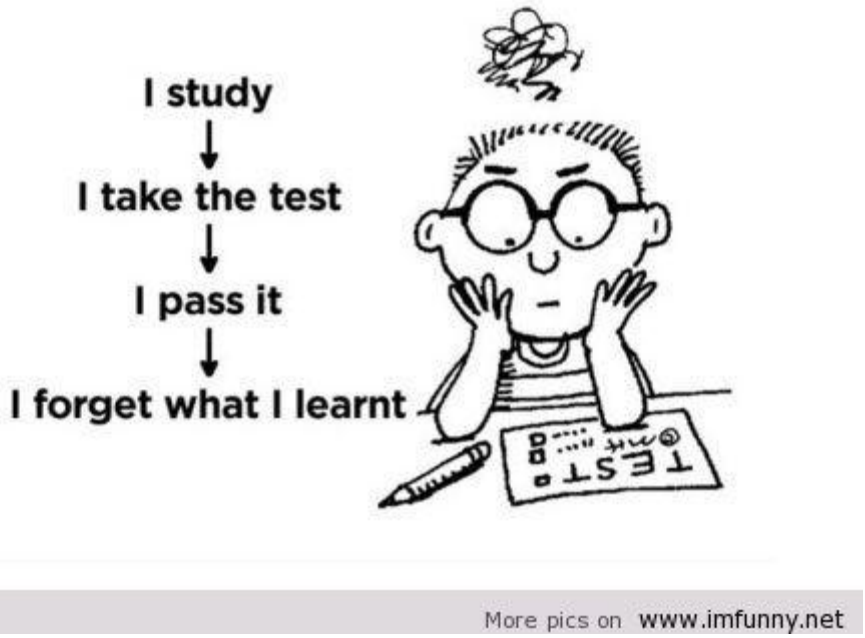
This question is very important and deserves due attention. One answer to such a broad based question is: "Mathematics makes the world go round because we cannot run away from numbers but have to manipulate them one way or the other."

"The more I tried to run away from numbers, the more I stumbled into them."

All other areas of study and research rely heavily on mathematics. The advancement of agriculture, astronomy and zoology has all been made possible by some knowledge of mathematics.

To be better positioned for any career, you need adequate and relevant knowledge of mathematics in your chosen career path. Any workplace requires the use of fundamental numerical and spatial skills in order to efficiently meet the demands of the job.

This numeracy enables you to become a better employee or employer. Further it prepares you to interpret work-related formulae, read statistical charts, deal with schedules and understand instructions involving numerical components.



"Mathematics is the best launch-pad for any career. It is the best leverage you can get."

It is necessary that as part of our life skills we should have basic financial mathematics for personal budgets and other applications of numbers. This may be a controversial view but after a second reading you might be saying, “Do I really need all that algebra, trigonometry and statistics to know how to budget?"
The answer is `**YES**`.

"Mathematics is to the mind what love is to the heart."

According to Ron Eglash and Toluwalogo B Odumosu (1999) of Renseelaer Polytechnic Institute, New York, “Most people engage in mathematical exercise unknowingly every day. Determining change in financial transactions is just one of the many abilities that require mathematical sensibilities. Time and space are also mathematically delimited as we all refer to our clocks for local time and unconsciously resolve the mathematical relationship between seconds, minutes and hours. The argument can easily be made that mathematics is all around us. This point must be fully understood by all doing mathematics”.

Every day in your life there is *'an equation'* to be solved, from simple linear equations to complex problems. It is just that at times you do not realize you are solving equations as it is not in a class setting hence the ease. In this case there is no pressure on you to perform, no peers to impress, no foes to scorn and humiliate you and definitely, no teacher to mark your answer.

Example

Now let me give an example where you solve equations without formally acknowledging it:

The price of a loaf of bread is increased by **90 cents** to become **R5.50**. What was the original price of a loaf of bread?
(Let ***x*** be the original price of a loaf of bread. It means that
***x*+ 90=550** hence the original price was **R4.60**)

This is a simplistic illustration but it just shows what kind of an equation you are solving in everyday life. Experience has taught me that most learners begin to struggle when the *'variable'* is introduced. Asking them to solve the above case
is not a problem; but the moment the *'original price'* is substituted by an *'x'* and the problem is called an equation then they convince themselves that they cannot do it!

These are some misconceptions that this book seeks to address. You are continually faced with mathematical demands which you should be able to handle with confidence. The demands frequently relate to financial issues such as hire-purchase, mortgage bonds, and investments. Many people are swimming in debt due to poor financial decisions which they take as a result of not knowing basic mathematics. Thus they are prone to bad advice from

retailers and friends. Do you want to be in debt because of mathematical ignorance? A definite 'NO' is the obvious answer.

Other everyday applications of math are: the ability to read maps, follow timetables, estimate and calculate areas and volumes, and understand house plans and sewing patterns. Cooking, use of medicine and other domestic activities require a proper understanding of ratio and proportion.

With knowledge like this, you can explore any career without limitations as math widens your scope and opportunities.

"Most things have been discovered by ordinary people with an extraordinary attitude."

Exercise:

1. List ten career paths that use mathematics and problem solving.

2. What is your desired job?

3. How will you apply mathematics in this job?

A trace of history reveals that almost all the great minds that left a legacy on earth had a connection with mathematics somehow.

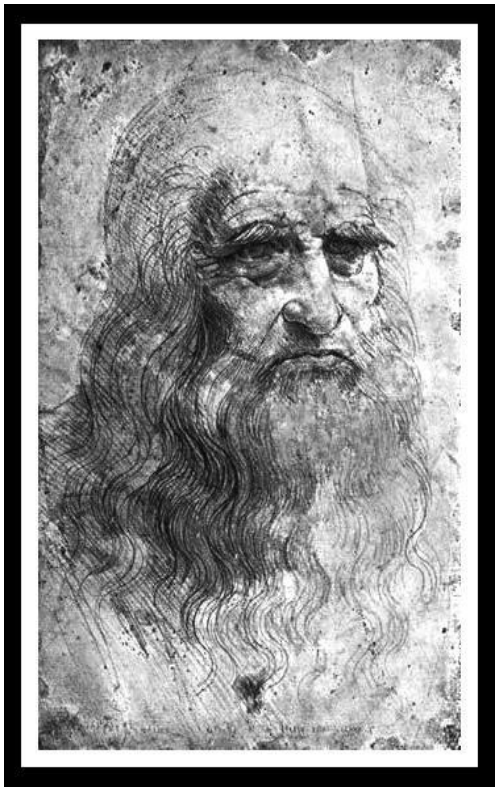
It is good that you have decided to read this book and it is evidence enough that you want to excel in math if done systematically this will surely open up a lot of doors for you regardless of what career you wish to pursue.

Mathematics is all around us and it is in your best interest to appreciate its concepts and apply it effectively. The buzzword nowadays is “Data” thus you should know how to manipulate data otherwise you become obsolete in this “data-driven society”.

Strive to apply every math principle you have learnt in school in all situations of your life and you will be smiling all the way to the bank (literally).

Great Minds and Achievers

FIGURE 1 – 1: POTRAIT OF LEONARDO DA VINCI



Leonardo di se Piero da Vinci

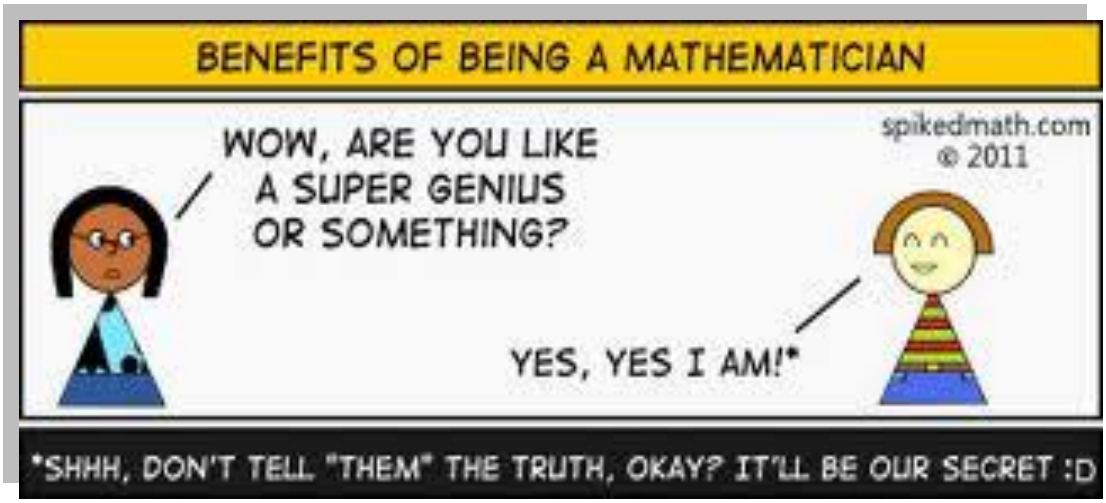
(1452 – 1519)

He was an Italian polymath – someone who is considered to be a genius in more than one field of study. According to Wikipedia, Da Vinci was an acclaimed engineer, scientist, inventor, painter, sculptor, architect, writer, botanist, musician and mathematician. His versatility worked to his advantage as he could crisscross from the so-called hard sciences to fine art.

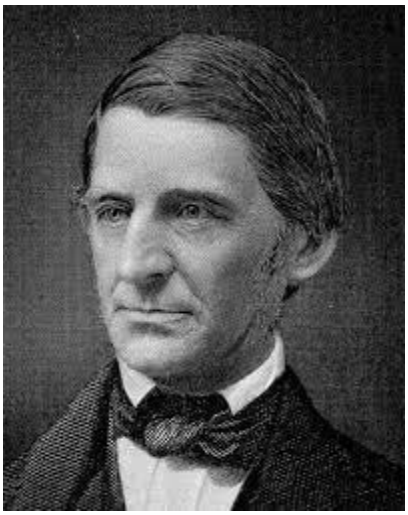
He pioneered in the design of many machines in use today namely: helicopter, tank, concentrated solar power, calculator, the double hull, and the machine for testing the tensile strength of wire. It was his knowledge of math, physics, and engineering that made him a better artist because he adopted an open-minded approach to problem-solving and also by beautifying some of his paintings, namely 'The Vitruvian Man', 'The Mona Lisa' and 'The Last Supper' using the mathematical ratio of 'Phi (1.618…)' which is also known as 'The Divine Proportion', 'The Golden Ratio' or 'The Number of Beauty'.

(This is my favourite number and I will look at it in detail in a subsequent chapter.)

One of Leonardo's driving forces to success was his curiosity of things not understood by man in his day.



1 – 2: POTRAIT OF RALPH WALDO EMERSON



Waldo Emerson (May 25, 1803 – April 27, 1882) was a philosopher, essayist, lecturer and poet of note who revolutionized the way many things are viewed. We can never divorce philosophy from mathematics since they are one.

Philosophy sets the basis for mathematical discourse and structures and logic which in turn gave birth to the Information Age through the advent of computers. Other philosophers of note were Plato and Descartes. The list of philosophers includes Turing who invented the Turing machine which opened a way for the study of Artificial Intelligence (robotics).

He emphasized the need for rational or logical thinking. This form of thought when mixed with the perceptive and intuitive thought can take you to greater heights in your walk to being a mathematical genius. This is the art of asking questions which is very beneficial in any discipline of study.

FIGURE 1 – 3: POTRAIT OF GALILEO GALILEI

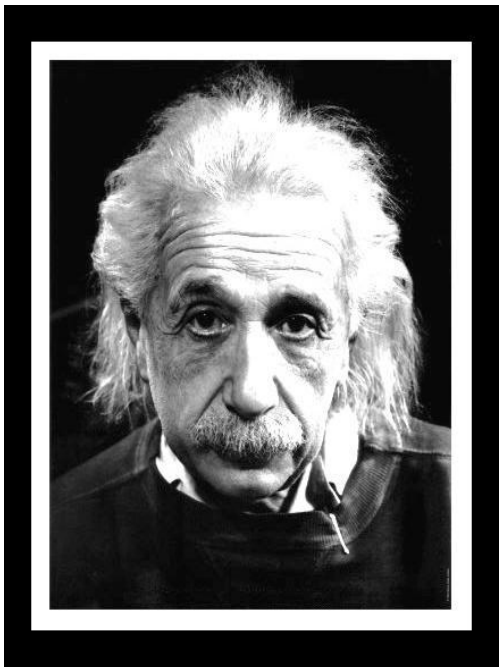
Galileo Galilei transformed the perceptions of astronomy through his accurate calculations despite opposition from the Church in charge during his day.

He believed and had faith in what he wanted to achieve and nurtured clear-cut goals and ambitions. He did not confine himself to the views of the majority but was after the truth which has changed all our lives for the better.

Just imagine in the 21st century still have been believing that if you keep traveling in a particular direction you will reach the edge of the earth and fall over to your death.

We would have been so stunted in thought and knowledge. It was good that the truth was discovered. This renowned scientist was born on February 15, 1564 in Pisa. Galileo was an Italian physicist, mathematician, astronomer, philosopher, and flautist who played a vital role in the Scientific Revolution. This great man was the first to use a refracting telescope to make imperative astronomical discoveries. His accomplishments also include improvements to the telescope and support for Copernicanism. No doubt for this reason Galileo has been called the “father of modern observational astronomy, “father of modern physics,” and “the Father of Modern Science.” In praise of Galileo Stephen Hawking said “Galileo, perhaps more than any other single person, was responsible for the birth of modern science.
(Source: www.famousscientists.org/galileo-galilei/)

FIGURE 1 – 4: POTRAIT OF ALBERT EINSTEIN



Albert Einstein (1879 – 1955)
German Mathematician and Physicist

He left his mark on the face of earth.
His quest for the truth led him to pioneer Quantum Physics.

Einstein was not satisfied by the laws of Newtonian Mechanics which every Scientist had embraced as absolute truth so he embarked on a quest to merge the laws of electromagnetism with the laws of Newtonian mechanics thus his renown equation $E = mc^2$ based on the Theory of Relativity was born. Albert always appeared to have a clear view of the problems of mathematics and physics and was determined to come up with a solution regardless of the circumstance.

He had the ability to visualise the main stages of the problem such that it opened doors for him in problem solving. He could focus and discarded irrelevant information from his mind as evidenced in his statement that, "I soon learned to scent out what was able to lead to fundamentals and to turn aside from everything else, from the multitude of things that clutter up the mind."

FIGURE 1 – 5: POTRAIT OF DR THAMSANQA KAMBULE

Names: Kambule, Dr Thamsanqa Wilkinson 'Wilkie'
Born: 15 January 1921
Died: 7 August 2009
In summary: Teacher and professor of mathematics.

Thamsanqa Wilkinson “Wilkie” Kambule was born in Aliwal North in the Eastern Cape in 1921. He did not start school until he was 11 years old. He progressed rapidly at the Anglican St Peter's in Rosettenville, Johannesburg, where he discovered his passion for mathematics.

After teaching at schools in Southern Africa, he returned to Johannesburg. In 1958 he was appointed principal of Orlando High School in Soweto. Over the next 19 years, he strove to ensure the best possible education for his pupils within the framework of "Bantu Education", the segregated and debased schooling imposed on Blacks intended to perpetuate inferiority. Constantly watched and checked by government inspectors, he would laugh as he told friends how he had responded to their suspicious questions with logical answers which left them floundering. They did not understand the wry sense of humour behind the straight face.

Kambule ensured Orlando High had facilities few black schools possessed. These included a library named after Sir Robert Birley, the former headmaster at Eton and a visiting professor in education at Witwatersrand University who took a special interest in the school.
Kambule led the Rand Bursary Fund set up by black teachers to keep pupils at school. Government funding was deliberately restricted and poverty among blacks was pervasive, so huge numbers of pupils lacked textbooks, or had to work to support their families. Kambule and his colleagues worked with the Rand Daily Mail newspaper to raise money from the public. For some years, more than a thousand children a year were able to complete high school.

It all came crashing down in June 1976 with the revolt by schoolchildren against government orders that various subjects, including mathematics, had to be taught in Afrikaans, rejected by blacks as the language of the oppressor. As the police shot and killed protesting children, education in the townships fell apart. The children's slogan was, "No education without liberation". Kambule worked with other teachers to persuade pupils to resume lessons. He did not succeed: his school was damaged and the Birley library was destroyed.

In 1977 he resigned, as did some 600 other teachers. He said it was futile trying to deal with the Department of Bantu Education. He took up a post teaching mathematics at Witwatersrand University and became the first black professor of mathematics at the university.

In 1988, he became head of Pace College, a private school in Soweto. It had 600 pupils, a tiny proportion of Soweto's 65,000 high school students, but was unusual because at that turbulent time, a total of only a thousand or so pupils were attending classes regularly.

After the fall of apartheid, Kambule became the first black person to be awarded an honorary membership of the Actuarial Society of South Africa - during the apartheid era he was not allowed to be a member. Professor Kambule retired in 1996, aged 75, and became principal of ORT Step College of Technology near Johannesburg.

In 2002, the Government awarded Kambule the Order of the Baobab in Gold for his exceptional contribution to mathematics education, human development and community service. Wits University awarded him a doctor of science degree in 1997 and the University of Pretoria honoured him with a doctorate of education in 2006. Professor Kambule's passion for mathematics continued in retirement and he taught privately at home.

On 7 August 2009, Professor Kambule, 88, passed away from a lung infection at the Unitas Hospital in Centurion, Pretoria.

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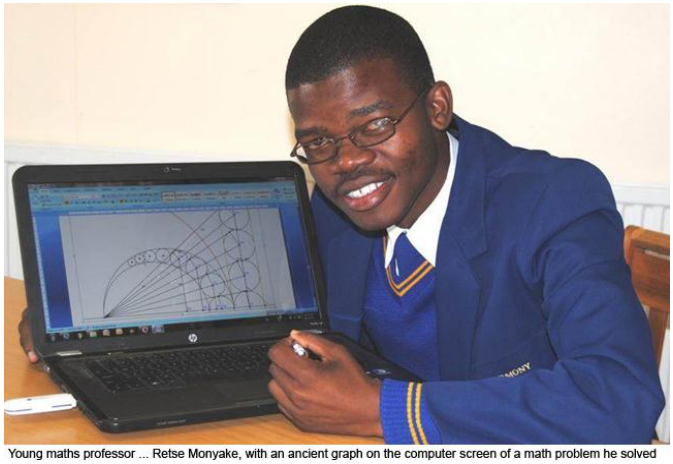
Source:http://www.sahistory.org.za/people/dr-thamsanqa-wilkinson-wilkie-kambule

Welkom maths genius represents SA

FIGURE 1 – 6: POTRAIT OF RETSELISITSOE MONYAKE



Young maths professor ... Retse Monyake, with an ancient graph on the computer screen of a math problem he solved

Retselisitsoe Monyake (17), eats, sleeps and lives mathematics.
The 17-year-old, from Virginia is a thinker and although he has reached great heights with his skills in mathematics, he remains a shy boy.

This brilliant matric pupil of the Harmony High School in Virginia was one of nine school children in South Africa who represented South Africa at the international science and engineering fair in Arizona, America. He was the only Free Stater in the group. Monyake was one of 1 500 participants from 70 countries who took part in the show in America and he finished fourth in the mathematical sciences category.

More than seven million students compete annually to represent their respective countries. Prizes and scholarships of over R40-million were at stake.

In October 2012, Monyake received a silver medal at the Eskom Expo for Young Scientists in Boksburg. His project dealt with a solution to an ancient mathematics problem, the Pappus chain statement. He won a silver medal, but was the winner in the mathematics category. When he was invited for the final screening, he initially did not want to go because he had only received silver at the expo. He said his greatest achievement is to have been a part of the international science and engineering fair in Arizona.

“It was my first time on an aeroplane. The hotel was very grandiose and I enjoyed every moment of being pampered like that. I was amazed that I did so well,” said Monyake.

Retse is the oldest child of Wetsi and Juliah Monyake. He has two sisters and a brother. His father works in the security section of Harmony gold mine.

The first time he realised he had a special gift in mathematics, he was in grade 7 at Laerskool Oos-Driefontein in Stilfontein when a teacher praised him about his mathematical abilities. This was just the encouragement he needed and mathematics became his favourite subject.

One of his teachers, Eben Engelbrecht said the school hopes Monyake gets nine distinctions in his final examinations. Thus far he has always received distinctions in all his subjects except Afrikaans.

“I am not a word person, especially when it comes to learning a new language like Afrikaans, but I will work very hard at it.”

Monyake usually gets full marks in mathematics and loves helping other students who are struggling with the subject.

With his prize money of R5 000 which he received in 2012 at the expo, he bought himself a computer.

He has not yet received his prize money of $ 500 (about R5 000) from the Arizona event, but hopes it will be in his account after the rand has strengthened. Monyake hopes to become an actuary one day. Source: theweekly.co.za/?p=17592

FIGURE 1 – 4: POTRAIT OF PROFESSOR MAMOKGETHI SETATI

Professor Rosina Mamokgethi Setati (née Mmutlana, born 1 November 1966) is a South African is mathematics educator & researcher, who holds the position of Vice Principal, Research and Innovation, University of South Africa . She was previously the Executive Dean of the College of Science Engineering and Technology of that university. In 2002 she became the first black female South African to obtain a PhD in Mathematics Education.

Mmutlana was born in Eastwood, Pretoria to Frank Mmutlana and Wendy Mmutlana (née Thipe). Her mother started as a domestic worker and factory worker who went back to school after giving birth to all her three children to complete Form 3 (Grade 9) which allowed her to study for her Primary Teachers Certificate and practice as a teacher. Her father, Frank Mmutlana, was one of the first black radio announcers at the South African Broadcasting Corporation (SABC).

She started school in 1972 at Ikageleng Primary in Marapyane village and Ikageng Primary in Ga-Rankuwa.She then attended the following schools; Tsela-tshweu higher primary; Tswelelang Higher Primary; Thuto-Thebe Middle School; Odi High School and Hebron.

She completed her matric with University Exemption in 1983(Grade 12) in the rural village of Hebron at the College of Education which also used to teach high school classes.

She achieved a BSc in Pure Mathematics at the University of North-West and a MSc in Mathematics Education at the University of the Witwatersrand followed by a PhD in Mathematics Education at the same institution.

Positions held:

- Executive Dean of College of Science Engineering and Technology of University of South Africa
- Honorary Professor of University of the Witwatersrand
- Professor extraordinaire of Tshwane University of Technology
- Deputy Chairperson of National Committee for the International Mathematics Union
- Trustee of FirstRand Limited Foundation
- Trustee of Telkom SA Foundation
- Board Member of South Africa, International Council for Science Board
- Managing Director of Pythagoras
- Source: en.wikipedia.org/wiki/Mamokgethi_Setati

There are so many legends that have used their mathematical ability to bring about change on the face of the earth. These include Isaac Newton, Gottfried Leibniz, Gauss; Euler, Pythagoras… the list continues.

I am quite sure right now you might be saying, "But these were geniuses!" I am also ready to tell you that you can be a genius too. It is a decision that you make, believe that it is true and work towards it.

This book has been prepared to inform you of your capabilities, your potential, that mathematical ability in you that is yearning to be exposed to the world for mankind's better future. It could be that you are the missing piece in the puzzle of the next great discovery. How will you realize your potential if you are going to be fearful of numbers that do not even breathe, whereas you are an immortal being who was created to rule?We were created to have dominion over 'everything' on earth and that includes mathematics.

"The mathematical genius in you is constantly begging to be unleashed to the world."

Mathematics is fun to do. The joy of solving a complex problem is amazing and uplifting as it actually prepares you for practical problem solving in life.

I know of some people who do math for the fun of it because it is a panacea to their worries and brings them joy and happiness. This mathematical journey is one that is worth exploring because it has countless benefits for you as an individual, the local community and mankind at large. I call it a *'journey*' because mathematics is a sequential and cumulative discipline. This means that everything you learn from day one will apply until you become the genius that you can be. It is taken step-by-step until you attain the success you want.

Confront math head-on and it will bow down to you, that is, if you have the correct mindset, which is why this book has been written to get you to the mathematical paradise where you will be able to face any problem.

"Conquer mathematics before it conquers you."

Exercise:

1. List any role models in South Africa who have excelled in mathematics?
2. Do you believe that you can be a maths genius?
3. What do you think is the most important mathematical discovery?
4. What can you do improve your mathematical ability?
5. How can you assist fellow learners in your community to improve in mathematics?
6. How can you use mathematics to solve some of the social problems in your society?

CHAPTER TWO

DISCOVER YOURSELF

"The worst thing that can happen to anyone is to have a wrong perception of self."-Anonymous

Killing the Ghost

To kill the mathematical ghost and master it, you have to know yourself. There are various ways by which you can get to understand yourself better these include introspection because you are the only person who understands you.

By being truthful to yourself you can discover your strengths and weaknesses. To assist you in this regard I have prepared

FIGURE 2 – 1: QUESTIONNAIRE FOR SELF ANALYSIS

Please place a tick in the appropriate column.

Statement	Explanation	No	Maybe	Yes
I like math	I enjoy learning math and solving problems			
Math is easy	I generally don't have problems doing Math			
My math teacher is good	My teacher explains well and I can follow as well as understand.			
My parents and siblings help me out with my math	I have extra help at home			
Math ability is in-born	People are born good or bad in math.			
Math is relevant to everyday life	I use math in my day to day dealings			
My intended career will have some mathematical application	I will use math in my future job			
I practice math often enough	I do sufficient math problems to excel			

Statement	Explanation	No	Maybe	Yes
I feel happy after solving a math problem	It is always a big joy for me to tackle a math problem			
I am an optimist	I always look at the brighter side even if the problems seem difficult			
My memory is very good	I easily recall learnt principles			
I am very creative	I look at a problem with an open mind and exhaust all possible ways and at times come up with my own method.			
I have a long concentration span	I can concentrate on problems with sufficient intensity for long enough to solve them.			
I am a go-getter	If I set my sight on an end result I always achieve it			
I am self - motivated	I know my goals and I believe I can achieve them			
I am a self-starter	I do not need to be pushed to do something			
I am not a procrastinator	I do not like postponing things that I can do now.			
I am self – disciplined when doing tasks	I start and finish tasks in time and am not controlled by external influences like peer pressure.			
I do not give up easily when faced with problems	I have a strong and resilient character such that I can make a plan to cope with any type of problem			
I can study independently	I can study on my own			
I am an organized person	I do things step by step in a logical manner			
I am able to manage my time	I put aside enough study time and I know how to use this time effectively			
I consider myself a responsible student	I commit myself to my studies. I find study help if I need it.			
I am comfortable gathering information.	I read books, magazines; newspapers... etc. I can use the library and the internet.			
I am confident of my mathematical capabilities	I can try any math problem. I can also confidently go for an exam.			
I have good study habits	I make notes every time I study and review my notes regularly.			

SELF ANALYSIS

Statement	Explanation	No	Maybe	Yes
I am able to link math with situations in real life.	I am able to do case studies based on learnt principles.			
I had a good math foundation	I have mastered the basic concepts and principles of math			
I prefer computer aided learning to teacher-led instruction in class	Would rather use math software than be in a teacher-led class.			
I am intelligent	I can learn anything			
I enjoy math Lessons	Every time I look forward to the math lesson.			

An Honest Self Assessment

Now that you have truthfully answered these questions you are actually in a position to see where you stand mathematically. In sum, your attitude and desired attributes for mathematical success have been displayed.

If all your answers were 'YES' then it follows that you are a math genius, I urge to keep it up and soldier on.

If most but not all your answers were YES then it is a good sign that you are on the right track to being a mathematical genius, you just have to address the negatives and gaps that prevent smooth progression.

If most of your responses were 'NO' then it means that you have to re-evaluate your ways of studying so that you can get on the path to being a math genius.

Above all it is a good sign that you are reading this book as it shows that you want to soar like an eagle.

"If I can just believe it, then I can do it." - I believe I Can Fly - R. Kelly

Exercise:

1. Do you set goals and plan before you embark on any mathematics topic or problem?
2. Do you believe that mathematics can be done easily if you train yourself to think logically?
3. Below is another questionnaire for you to complete. Once you have answered all the questions compare your answers with the ones in the table above.

Please answer the following questions with as much honesty and detail as possible. Your responses are anonymous so there is no need to be embarrassed about your responses. It is important to give your true feelings as it will have the best impact on your future learning.

Please complete the following sentences.

1) I learn most in maths when…

2) I enjoy maths most when…

3) I don't like maths when…

4) I don't learn as much when…

5) My favourite types of activities are…

6) If I need help I…

Source https://www.ncetm.org.uk/public/files/.../**Student**+**Questionnaire**.doc

CHAPTER THREE

WHAT DID THE GENIUSES HAVE IN COMMON?

"In order to succeed, there has to be a big desire, a desire so strong that it permeates the subconscious mind."
– Marc Fisher and Marc Allen (From How to Think Like a Millionaire)

The Go – Getter Characteristics

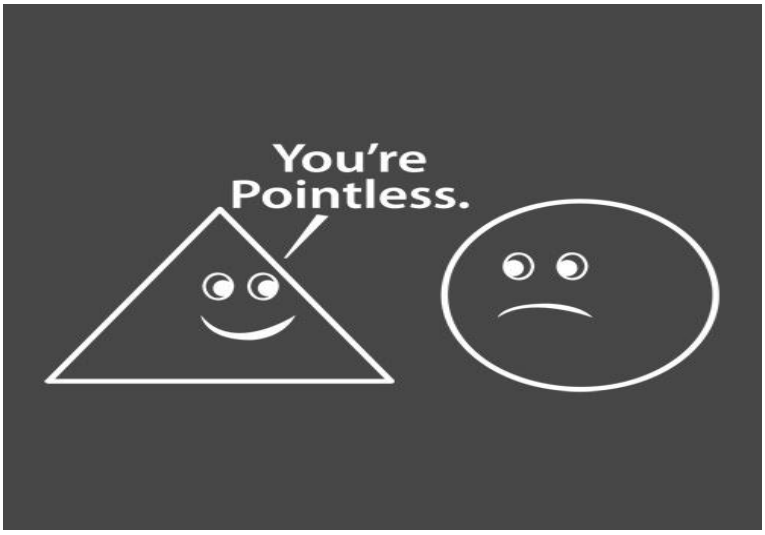
The so-called pathfinders in mathematics and the sciences in general had particular characteristics which enhanced their ability to discover, invent and obtain solutions to problems. These great men and women had breakthroughs in disciplines that had never been heard of before. They were pioneers in their areas of study and their strength came from:

- A focus on what they wanted to achieve and not giving up. (persistency)
- A systematic and orderly approach to problem solving.
- They had a hunger for the truth. They did not compromise, but strived for perfection.
- A die-hard (not giving up) attitude where adversity, hostility and other constraints did not deter them from reaching their intended goals.
- Nurturing their creativity by approaching a problem in many different ways so as to exhaust all possible channels and solutions, and then settle for the best of them.
- Ability to look at things in a fresh, almost childlike way. Keeping an open mind and a flexible attitude on all subjects.
- Not polluting their minds with garbage but filled their '*hard drives*' (minds) with facts and information that would help them in their endeavours.
- An inquisitive spirit i.e. they asked a lot of questions as to why things were the way they were.
- Concentrating on a problem with more depth and intensity compared to any mediocre person.
- A passionate drive to succeed in anything, and they loved and enjoyed what they did such that they pursued their dreams with astounding energy and zeal.
- Not settling for anything less than perfect and pure. They did not compromise in their quest for excellence.
- Daring to be different and being considered 'crazy' and labelled as "radicals", "fanatics" because they did not go with the masses thus they fought mediocrity.
- Mastering the art of visualizing problems and their respective solutions.
- Being confident of their abilities and maximized on their potential. Hence they believed their work was to be a success and it would change mankind's way of life.
- Being selfless because they did it for the good of mankind.

"Geniuses often have crisp, clear-eyed visions of what they want to achieve and they will act and behave on the basis of the intended goal usually with tremendous energy." - Anonymous

These characteristics were definitely not in-born but acquired through consistent practice and a passion to be the best.

You can be the best if you decide to focus and put all your energy into it. You have to love and enjoy what you do, to be the best. The following chapters expand and further exemplify the winning formula introduced in Chapter three.



Success in mathematics depends on your ability to respond to the challenges presented by new problems and new ideas. The attributes described below are crucial to success both in mathematics and in other disciplines.

Demonstrate intellectual engagement.

- Perceive mathematics as a way of understanding — a view that mathematics must make sense, and is not a sequence of algorithms to be memorized and applied.
- Actively explore new ideas, posing questions about their meaning, significance, and implications.
- Recognize patterns–as well as deviations–from previously learned patterns in data, diagrams, symbols, and words.
- Appreciate that abstraction and generalization are important sources of the power of mathematics.
- Be willing to take risks and be challenged as part of the learning process.
- Contribute to and benefit from group problem-solving activities.

Take responsibility for own learning.

- Attend every class session and when absent, seek ways to learn the material covered in class.
- Conscientiously prepare work assigned for class.
- Examines and learns from his or her errors and seeks help when needed.
- Takes advantage of available resources — class time, notes, textbook, assignments, tutoring services, supplemental materials.

Persevere when faced with time-consuming or complex tasks.

- Set aside the time necessary to be successful.

- Be willing to work on problems that require time and thought, particularly problems that cannot be solved by mimicking a previously seen example.
- Successfully complete tasks that require organizing and implementing multiple steps, concepts, or techniques.
- Recognize when an approach is unproductive and make logical modifications to that approach or switch to another approach.
- Be convinced that effort is an important component of success in mathematics.

Pay attention to detail.

- Correctly follow all parts of oral and written directions without needing additional reminders.
- Make few notational errors, e.g., accidentally changing digits, dropping or altering algebra symbols, incorrectly positioning points on a grid, etc.

Source: http://transitionmathproject.org/index.php/projects/detail/student-attributes-for-math-success-sams

According to Michalko Michael, author of Thinking like a Genius, the following strategies encourage you to think productively,
rather than reproductively, in order to arrive at solutions to problems. "These strategies are common to the thinking styles of creative geniuses in mathematics, science, art and industry throughout history."

Nine approaches to creative problem solving:

1. **Rethink!**

   Look at problems in many different ways.
   Find new perspectives that no one else has taken.

2. **Visualize!**

   Utilize diagrams and imagery to analyse your dilemma.
   a. How can you use pictures, images, graphs, etc. in your studies?
   b. Visit guides on concept or mind maps, picturing vocabulary, flashcards, etc.
   c. Write out one example of how you can use imagery, then print and post it in your study area.

3. **Produce!**

   Genius is productive.
   a. Perhaps originality is not the key, but rather constant application of thought and tools to arrive at solutions.

b. *Geniuses are the luckiest of mortals because what they must do is the same as what they most want to do.*
W. H. Auden (1907–1973) Anglo-American poet

c. *Genius is nothing but a great aptitude for patience*.
George-Louis Leclerc de Buffon (1707–1788) French naturalist

4. **Combine!**

Make novel combinations...
Combine and recombine ideas, images, and thoughts into different combinations no matter how incongruent or unusual.

5. **Form!**

Form relationships. Make connections between dissimilar subjects

6. **Opposite!**

Think in opposites. Don't always stick with the obvious solutions.
Get outside of your comfort zone.

a. "Opposites" bring two approaches to a situation but they do share a basic similarity.
Example: "right" and "left" are both directions, but which is the right choice?

b. The Sesame Street Muppet *Elmo* teaches small children the concept of opposites!

7. **Metaphor/simile!**

Think metaphorically.

a. Metaphors are connections that are unusual or not an ordinary way of thinking:
A sea of troubles; the heart of a lion; raining cats and dogs.

b. Similes use "like" or "as" to illustrate
The boy was as agile as a monkey. *The miner's face was like coal*.
The task was as easy as ABC. *Dry like a raisin in the sun*.

8. **Failure!**

Learning from your mistakes is one example of using failure.

a. As strange as it seems the human brain is failure machine: it generates models of reality, acts on them, and adjusts or creates new, successful models based on failures.

b. From Daniel Coyle's *the Talent Code* on Adam Bryant's weekly interview: "*every single CEO shares the same nugget of wisdom: the crucial importance of mistakes, failures, and setbacks*… mistakes create unique conditions of high-velocity learning that cannot be matched by more stable, "successful" situations."

9. **Patience!**

Don't confuse inspiration with ideas.
Apply your ideas with patience for the reward they may deserve

CHAPTER FOUR

CLEAN YOUR HARD- DRIVE

"Our business in life is not to get ahead of others, but to get ahead of ourselves –to break our own records, to outstrip our yesterday by our today." - Stewart B. Johnson – British artist known for his figurative work.

Myths about Mathematics

Cleaning your mind is the foremost step on your journey to becoming a math genius. As you were growing up you could have always been told that *'math is difficult'.*

You find that at home everyone tells you how difficult math is, when you get to school it seems as if the teachers make it even more difficult. You have always tried your "best" but you do not get the good grades.

So you ask yourself where the problem is. This book will allay your fears and suggest a way out .You might have been trying very hard in the wrong way. The answer to your problem lies in YOU and it is there for you to discover. Given the correct foundation not even the sky is the limit for you.

The mind is like a computer hard- drive. What you input is what is going to be output. You cannot run a program that has not been installed. So ask yourself what kind of programs you are downloading and programming into your mind, further find out which of these programs have taken up more space on your hard-drive.

Your mathematical ability is a function of your inner programming from a very early age up to now. In other words, ability is dependent on your mind-set and the dominant thoughts you hold in your mind.

For example, if you spend most of your time watching TV or doing unproductive activities, then definitely you are going to know all the programs on TV, their presenters and all the actors, thereby filling your mind with that information which I doubt will be useful in your mathematical ambitions. I am not saying do not watch TV, but simply pointing out that does not make it an activity that dominates your mind. It is a fact that most of programmes on TV are not beneficial to the viewers in the long run.

At the end of each day you should ask yourself if you have added any value to your being. If you do not improve yourself each day, you will become irrelevant and outdated in the near future. You will be like a cassette in the CD era.

Now you can make a self-check questionnaire about how you are allocating time to the different activities.

This will enable you to discard useless, unproductive activities to concentrate on the relevant and vital activities

"Mental garbage is like sand in your car engine."

Surely your engine (the mind) will not run efficiently if there is sand in it .It is your duty to remove the sand. It is your job to maintain your engine by removing unwanted and unproductive information while loading as much vital information as possible.

Like any other machine, your mind needs to be taken care of so that it can operate optimally. The doctor says that you should

'Store your pills in a cool, dry place'.

The butcher tells you to *'refrigerate your meat*' so that it can be edible in future. For your cell phone to be efficient you need to 'charge the battery and ensure that it is fully charged'. This applies to the mind as well.

For your mind to function at the best of its ability, it has to be used continually with definiteness. The more maths your mind encounters the more it will be able to process any mathematical problem.

"If you want your external world to change, you have to start with your internal world. The more you change your inner being, the more you are likely to impact and affect the things around you." - Anonymous

Never listen to the misconceptions of those who intimidate you by magnifying the difficulty of math. At least now, you know it can be conquered but you first have to remove the sand in your engine (mind).

That sand is like a virus that has attacked your hard drive and is stopping you from doing your best. You have a mathematical journey to travel and it is one journey that many ill-informed people dread.

Students' interest in the content area of the task and their beliefs about the utility of the task are also important. In mathematics education students' interest in mathematics, their beliefs in the utility of the mathematical knowledge in their future career or in their everyday life determine in a fundamental way their problem-solving behaviour. „Belief systems are one's mathematical world view, the perspective with which one approaches mathematics and mathematical task. One's beliefs about mathematics can determine how one chooses to approach a problem, which techniques will be used or avoided, how long and how hard one will work on it, and so on." (Schoenfeld, 1985, p. 45)

But it is a journey that is rewarding and satisfying thus worth giving a try. Get down and start calculating and you will see and enjoy the fruits of your labour.

"Effective learners recognize the importance of reflecting on their thinking and learning from their mistake. Students should view the difficulty of complex mathematical investigations as a worthwhile challenge rather than an excuse to give up.
Even when a mathematical task is difficult, it can be engaging and rewarding. When students work hard to solve a problem or to understand a complex idea, they experience a very special feeling of accomplishment, which in turn leads to a willingness to continue and extend their engagement with mathematics."- (NCTM, 2000, p. 21) National Council of Teachers of Mathematics

CHAPTER FIVE

PASSION

"I move mountains with my will to succeed that is how I keep going."
-Testimonial - P Diddy – Rapper, Record Producer, actor, fashion designer

Go for passion

> *According to the Oxford dictionary passion is a "strong emotion." I take it to be a desire so strong that it recognizes no failure and obstacles.*

If you are passionate about something, it is almost impossible to dissuade you from doing it. That is the kind of desire for success you must adopt, if you are to excel in math.

"Life gives you what you sincerely want .You will become as great as your dominant aspiration. If you cherish a vision, a lofty ideal in your heart, you will realize it. If you are content with mediocrity, that is what you will have." – James Allen (1864 – 1912)

The moment you have a passion in something you develop faith and actually believe you can do it. I personally have been propelled by self-belief and it has triggered a lot of positive and desirable characteristics in me.

I have always said that I will not be defeated by numbers that neither breathe nor think like me. So, this kind of thinking has led me through many mathematical victories.

Passion leads to self-confidence and this will give you the energy to focus and work even harder because you expect positive results. You can begin with the easiest to the hardest mathematical problems.

First things first – basic principles and then the more challenging

At the root of every great discovery and exceptional success story lies a dream, an aspiration, a desire. This desire transcends cynism and strictly rational thought."-Anonymous

Passion is the key driver for anyone who has become successful. Some call it the “Heart” necessary to succeed. With passion you are fired to endure any difficulties and overcome any obstacles in your way.

Push yourself to be a mathematically passionate person who immerses himself/herself with great intensity until a problem is solved.

Solving the Attitude Problem

Before attempting any problem, first sort your attitude towards it. Convince yourself that you can do it and keep an open mind so that you can tackle it from any dimension or perspective. Do not limit your imagination and creativity by looking at a problem from one perspective, but be versatile and try out all the possible ways of solving it.

Sometimes the answer will actually come from seemingly unrelated routes, the very unorthodox means and ways. The unconventional methods could actually be a new way of solving that particular problem. The problem that most people have is not being sure of their potential hence end up limiting themselves. Refuse to limit yourself and ride on the crest of the mathematical wave.

In the questionnaire in **Chapter Two** you were asked what feeling you get after solving a problem. The reason was that you should feel ecstatic after solving a problem even if it means running around, doing a victory dance this is a way of congratulating yourself after a duel with the sums.

Remember Archimedes ran across town naked because he had cracked a problem. He was so passionate about the displacement problem that it dominated his mind even as he was bathing. He focused and totally immersed himself into the problem at hand, it dominated his mind. He finally cracked the problem due to his unwavering faith and persistence.

Isaac Newton was so passionate about gravity that everywhere he went it occupied his mind. If Galileo was not passionate about astronomy right now we would still be thinking that the sun moves around the earth and a lot of other misconceptions held at the time.

The first and last thing demanded of a genius is the love of truth." – Johann Wolfgang von Goethe, German (1749-1832) – poet, humanist, theologian and scientist.

To sum up, just have the self-confidence, belief and faith that you can tackle any problem with ease.

Faith is not simply hoping that things might work out. It is being sure that you will make it even if all odds are against you. It is knowing that, what you want to solve is solvable - just a case of you finding the way. Believe that any mathematical problem has an answer waiting for you to discover. Have that faith that will not be wavered by the hurdles you are bound to meet. There is a saying that you are as handicapped as you choose to be. Do not limit yourself. Problems in mathematics, just as in life, determine who you are going to be. The problems you encounter in life and your attitude to them shape your future relationship with them.

"The only worthwhile life is a life which contains its problems, to live without any longings and ambitions, is to live only half way."- L.A. Averill

We all encounter problems but your response or reaction to the problem is what matters. Are you going to give up or are you going to face it head-on? Can you imagine the knowledge and experience you get if you manage to solve it. That is where the joy, ecstasy and satisfaction are. In mathematics the more problems you solve, the more the experience you get and the more confident you become.

Problems are the cutting edge that distinguish between success and failure. Problems call forth our courage and wisdom. Wise people learn not to dread but to welcome problems, because it is in the whole business of meeting and solving problems that life has meaning." - From the Road less travelled authored by M. Scott Peck (1936 – 2005)

You have always heard that experience is the best teacher. If you practice long and often enough, you will be experienced in problem solving, such that it becomes your second nature. It surely becomes a part of you. The experience ignites the passion to an even higher level. The more problems you tackle, the more passion, faith and self-confidence you get. Solving problems is the business of your life.

I believe that maths education and excellence is for every child. I believe that with a mathematically literate society, Africa's fortunes will be changed economically and socially.

Join the fight for true African emancipation through education, mathematical excellence is the most viable conduit to success, play your part in liberating Africa.

CHAPTER SIX

PRACTICE MAKES PERFECT

"If at first you do not succeed just pull yourself up and try again."
Try Again-Aaliyah (1979 – 2001) – R & B musician.

The Greats

Have you ever noticed how:

- Ronaldinho juggles the soccer ball with so much ease!
- Tiger Woods dominates in golf!
- Doctor Khumalo was such a prolific attacking midfielder.
- Brian Habana is such a great rugby player.
- Bill Gates is at the fore front of innovation!
- Connie Ferguson graces our television sets with elegance and confidence - always flawless!
- You do not have to make complex decisions as to whether you should put the left or right leg forward when walking!
- You write and do not have to think how to shape the letters!

There are so many things you do spontaneously because you have done them over and over such that they have become part of you. To be a mathematical genius you have no option but to follow the same route. There is no other better way to learn math except through consistent repetition and continual practice. Learning mathematics is a cumulative experience; it is sequential by its nature where each day's work builds on the previous day's.

In this world there is no-one who invented as many things as Thomas Edison because inventing became part of him so much that he did it with ease. This is not something he was born with but he acquired it through practice. (It took him more than 10 000 failures until he discovered the light bulb.)

The problem most students have is that they postpone math practice and try to do a crash course towards examinations. This *modus operandi* does not work. You need to learn all the concepts and how to apply them one step at a time. This starts on the first day to the last day of the year. You should make it a point to reserve enough time for your mathematical needs on a daily basis. The more you exercise your mental muscle, the more productive you will become.

Athletes are required to be physically ready for the various competitions. The same applies to the mind which needs to be fit to function at the best of its ability. Different people have different ways of stimulating their brains so do that thing that makes you mentally fit.

"By practicing math consistently you are expanding and nourishing your mind"

Practice, Correct Practice Makes Perfect

If you go back to the list of things mathematical geniuses have in common, you will see that they all had an extra-ordinary ability to concentrate deeply and for longer periods. This feat is something you learn to do.

If you put a piece of paper in direct sunlight you will see that little or no change occurs to it.

But if you take a magnifying glass and place it in such a way that the sunrays are focused on a particular point on the paper, this will result in the paper burning. This is the same principle of focus and concentration where an exertion an adequate amount of concentration for an adequate period of time,you will crack any problem.

Take note that this will only apply given that you have the necessary basics to manipulate the problem because no matter how much you think without the necessary theory, it willbe in vain.

"If you know the basic concepts and formulae then you can utilize your concentration and focus power to come up with the solution."

For you to keep doing something over and over again you have to love and enjoy it, otherwise it will become monotonous after a few trials.

This brings me to the point where I need to clarify that becoming a mathematical genius does not require that you be interested in math but be committed until you attain that goal.

Commitment means that you will let go of all those activities that are not in line with your aspirations and focus on your studies fully.

Everyone in this world is interested in getting rich, getting a better job and having everlasting peace and happiness.

But if you are not committed to the cause, then it will always be wishful thinking - a complete pipe-dream where there will be no light at the end of the tunnel. I remember my high school mathematics teacher who used to say "*suffer now and enjoy later*." I am here to change that and inform you that practicing math consistently will not be suffering if you adopt a positive attitude and self-immersion in your work.

Instead it will actually be a source of entertainment and you even reap the fruits of your fun. Therefore the saying should be "*Enjoy the practice now and enjoy the benefits later*."

When practicing, do not just take it as one of the chores that you have no option but do. Instead, take a proactive stance and go the extra mile .If your teacher gives you three sums to do, you can add three more so as to make sure that you have grasped the idea .The more problems you encounter and solve the more confident you become and the more productive you become. Doing mathematics is like going to war where you are supposed to outwit the enemy. In this case, the problem you are supposed to solve is the enemy.

An Army General is respected through the number of battles and wars he has won for his country. You are a '*general*' and you should count how many topics in the syllabus you have conquered. Each day make it a point to fight the mathematical fight until you take the ultimate prize.

Fight the fight as if your life depended on it, for it surely does. Reading this book is a very good step which I highly appreciate, but on its own it is not enough. The application of these principles, combined with techniques taught by your teacher will ensure success. As suggested above everyone wants the good things of life, but only those who will go out of their way to attain their dream will live the higher life of abundance, satisfaction and peace.

Success is in the mind – it is a mind-set, a way of life –You create your own ceiling in life, if only you knew that not even the sky is the limit."

You are the one who knows where you stand mathematically and it is your duty to establish how you shall implement the basic principles. Do not settle for anything less than perfect, do not compromise at all. Success is yours if you apply yourself to the cause. Start today, procrastination is the worst evil that you can encounter. Do not postpone, start today.

> *"There is a world out there I wanna see. There is a man out there I wanna be. The fact that I'm from the ghetto ain't gonna stop me. I believe it can be done and we start somewhere. I can see the best in me and I will turn my life around and be who wanna be"*
>
> *- Joe-Ghetto Child (1973 -) R & B Grammy Nominated musician*

You are the one who knows where you stand mathematically and it is your duty to establish how you shall implement the basic principles. Do not settle for anything less than perfect, do not compromise at all. Success is yours if you apply yourself to the cause. Start today, procrastination

CHAPTER SEVEN

HOW TO ATTACK A MATHEMATICAL PROBLEM AND COMMUNICATE EFFECTIVELY

"The essence of mathematics is not to make simple things complicated, but to make complicated things simple."

- S. Gudder

Strategy

Mathematics is essentially a different subject in that it requires you to be proactive and involved because it is a DOING subject where you have to solve problems.

Efficiency and ability in solving problems is a guarantee for success in learning it. To attain this efficiency you have to adopt a systematic and orderly approach to problem solving.

Research has shown that in any given problem there are four basic steps which will generally get you to the solution. In 1945 G.Polya discovered these steps:

1. **Understand the problem**
2. **Devise a plan**
3. **Carry out the plan**
4. **Look back and check if correct**

These four steps are what we term the '*skeletal system*' of problem solving. You have been using these steps ever since you started doing mathematics, but maybe you did not realize it.

Solutions do not come by luck; instead they do through a well laid out plan.

Once you get a hold of these steps and use them intentionally and consistently, you will find out that your mathematical limitations are unreal.

UNDERSTAND THE PROBLEM

Here are some suggestions leading to understanding the problem:

1 Read the problem carefully, step-by-step.
2 Look at the problem from different directions and angles (check all possible cases and scenarios) even those that seem silly.
3 Recognize patterns if there are any.
4 If possible you can list down analogies or examples.
5 Identify underlying relationships and connect to other topics and subjects.
6 Identify what the problem requires you to find or prove and what information you are given to help you. Know what is expected of you.
7 Take time to think and weight the problem.

N/B: Not all problems require all these sub steps; it is at your discretion to know what applies to what.

"A mathematical genius appreciates the elegance and beauty of solutions to problems and the many paths leading to them." – Anonymous

DEVISE AND CARRY OUT THE PLAN

Now that you have understood the problem, the second and third steps are to devise a plan on how you are going to attack the problem. The method is determined by the information given and the desired solution. The information given will give you an indication of the method or formula to be used.

Once you have been able to pin-point which formula to use then carry out the plan showing every step taken so that if given to anyone they can follow. Once you have your result it is important to evaluate, which is the next step. In point form, after understanding the problem then:

- Identify which skills and techniques that you have learned can be applied to solve the problem at hand.
- Decide on a method or procedure, step-by-step. The given information usually guides you to the method you are supposed to use.
- Check to see what units, measurements and instruments are to be used.
- Break the problem down into manageable steps and do not try to tackle them at once. One step at a time.
- Use methods such as tables, graphs and sketches for diagrammatic recording wherever possible. These help in understanding the problem through visualisation of patterns and trends pictorially.
- Calculate your solution, express the relationship in general terms, hence connect the data, reach a conclusion and interpret to real life circumstances.

LOOK BACK AND CHECK IF CORRECT

Evaluation is critical because this is when you check to see if the devised method worked as expected. In the case of equations you can substitute your solution back into the equation and if it balances then you know your solution is correct. If not then it means you will have to check your method and steps for any errors or mistakes.

As a summary to the problem solving procedure, I will give you the method called ‘Verbal Maths Problem solving’ which has been adapted from Ackerman, Anhalt and Dykman (1986)
It is essentially the same thing as the one above but it might assist you to understand the problem solving concept better. The steps are as follows:

- Read the problem aloud.
- Paraphrase the given important information.
  Repeat the given question aloud. What is being asked? What you are looking for? (Task)
  Identify what you have been given.

- Visualize:
  Draw a diagram where necessary

- State the problem:
  I have ….I want to find…

- Hypothesize

  If I … then …
  How many steps do I need?
  What units of measurement am I supposed to use? What terms?

- Estimate

- Calculate

- Label

- Self-check: Every step
  and calculation

- Ask, "Does it make sense?", “Does it answer the question?

"Creative geniuses have a particular way in which they arrive at their perceptions of the world. They have a lens through which they view society and problems to arrive at radically different conclusions to that of ordinary people." - Anonymous

Following these procedures will surely lead you to success in any problem solving situation. You would have noticed most employers want employees with a mathematical background and the reason being that mathematicians can tackle any situation presented to them by applying these principles.

With practice and self-belief, this will become second nature and there will be no need to refer to the list above because it will be within you.

Effective Communication

The Problem and the Answer Relationship.

Communication is the science and practice of transmitting information. Information sent out should have a targeted receiver.

In mathematics when the examiner or educator asks a question, he or she is sending information which you are supposed to receive, analyse and process. You then send feedback in the form of an '*answer*'.

The answer or solution should be understood by the examiner so as to give you full marks there it is important to clearly state all the steps that you have taken.

It is necessary to master the mathematical language so as to communicate effectively. Mathematical language refers to the use of mathematical symbols and numbers to explain phenomena and any given situation to greater effect.

When writing your solution, try and keep it as simple as possible, but at the same time, not leaving out vital information. Some have called mathematics an economical language where everything has been shortened.

This is true to some extent since the idea of math is to simplify complicated things. All your solutions to tests, assignments and investigations should demonstrate that you have fully understood the problems from the beginning to the end.

This implies that when you are reading the question, you do it with a deliberate purpose to '*extract*' relevant information and link it to known mathematical principles. Where possible, use pictorial illustrations such as diagrams, to help your explanation or argument.

"Take the first step in faith, you don't have to see the whole staircase, just take the first step."
- Dr Martin Luther King Jr (1929 – 1968)

Generally, students have problems with word sums, so I have made it a point to dwell on that aspect and show you different ways of attacking the problems. The next chapter is dedicated to that cause.

"If you have a problem you cannot solve, write it in a different way." – G. Polya (1887 – 1985)
– Hungarian mathematician

CHAPTER EIGHT

WORD PROBLEMS

"Create a positive self-image. If you are confident, secure and have good self-esteem, you will have personal power. If you have a fear of failure and are unhappy and insecure internally, you are setting yourself up for failure. If you are not clear about what your core and emotional need values are, you will not have personal power." - Anonymous

Into The Mathematical Language

In every problem there are always clues that you should be able to identify. These key words will guide you as to which operation to employ where a mathematical operation is a process of carrying out rules of procedures, such as addition, subtraction, division and multiplication. Here are some particular examples.

FIGURE 8- 1: TABLE SHOWING WORDS USED FOR MATHEMATICAL OPERATIONS

OPERATION	WORDS OFTEN USED	EXAMPLE	RESULTS
Addition	Add	Add 10 and 5	10 + 5 = 15
	Find the sum of	Find the sum of 10 and 5	10 + 5 =15
	Plus	10 plus 5	10 + 5 = 15
	Combine	Combine 10 and 5	10 + 5 =15
	Together	10 and 5 together give	10 + 5 = 15
	Increase… by	Increase 10 by 5	10 + 5 = 15
	More than	5 more than 10	10 + 5 = 15

	Total of	Total of 10 and 5	10 + 5 = 15
	In all… and… give	In all 10 and 5 give	10 + 5 = 15
Subtraction	Subtract…from …	Subtract 6 from 11	11 – 6 = 5
	Minus	11 minus 6	11 – 6 = 5
	Difference	The difference between 11 and 6 are	11 – 6 = 5
	Less	11 less 6	11 – 6 =5
	Less than	6 less than 11	11 – 6 = 5
	Take away	11 take away	11 – 6 = 5
	How much more	By how much more is 11 than 6?	11 – 6 = 5
	How much less	By how much less is 6 from 11?	11 – 6 = 5
	Exceed	By how much does 11 exceed 6?	11 – 6 = 5
Multiplication	Multiply… by…	Multiply 4 by 10.	4 x10 = 40
	Product	Find the product of 4 and 10	4 x 10 = 40
	Times	4 times 10	4 x 10 = 40
	Of	50% 0f 260	50% x 260 = 130
	As much as	Thato has twice *as much* balls *as* Thulani who has 2 balls.	2balls x 2 = 4 balls

Division	Divide…by…	Divide 100 by 10	100 ÷ 10 = 10
	Find the quotient of	Find the quotient of 100 and 10.	100 ÷ 10 = 10
	Share…among …	Share R100 among 10 people	R100 ÷ 10 = R10.
	Distribute	Distribute R100 among 10 people	R100 ÷ 10 = R10
	Ratio	What is the ratio of 100 to 10?	10:1
	Proportion	What is the proportion of 100 to 10?	10:1
	Out of	100 out of 10	100 ÷ 10 = 10

These are just the basic and there are a lot more words that can be used. Look out for synonyms of these words as there are so many types of '*word problems*' hence there is a need for different strategies in tackling them. You need to pick the strategy that fits the problem best.

1. Multi-step Problems:

The idea here is that you need to break the problem into manageable steps. The vital thing is knowing the sequence of what to find first.

Example:

10 men can finish a job in 5 hours. How many men are needed in order to finish the job in 25 hours?

Knowing that

10 men finish the job in 5 hours; we need to find how many men are needed to finish in 1 hour (5 ÷ 1)10 = 50 men.

Now to get the number of men who would finish the job in 25 hours (1 ÷ 25)50 = 2 men

It was essential for us to first '*calculate*' the number of men needed for 1 hour, so that we could make life easier to calculate for any given number of hours hence we proceeded to calculate for 25 hours.

2. Extra-information:

Sometimes a problem has extra information that is not needed in finding the solution so be on the guard for such.

Example:

Yesterday Tebogo went to the supermarket to buy 10 oranges, 5 apples, 3 bottles of juice and 20 guavas. How many fruits did she buy all in all?

Do you think that the 3 bottles of juice are going to help in finding the solution?

So always check to see the relevance of given information. Some information is just meant to divert your attention.

3. Logical Reasoning and use of Venn Diagrams:

There are a lot of questions that demand you to reason your way out. It is just a matter of making sense of the problem. Reasoning is enhanced by diagrams because it helps you visualize the problem pictorially. In the example below, sets have been used to simplify the problem. Venn diagrams are the pictorial representations of sets.

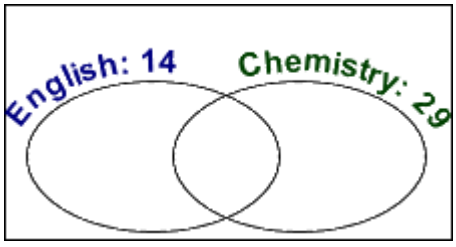
Example:

Venn diagram word problems generally give you two or three classifications and a bunch of numbers. You then have to use the given information to populate the diagram and figure out the remaining information. For instance:

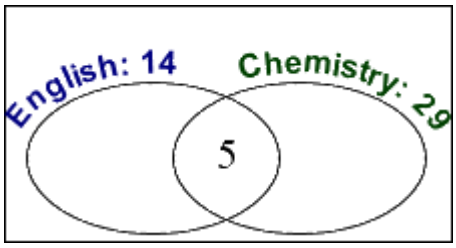
- Out of forty students, 14 are taking English Composition and 29 are taking Chemistry. If five students are in both classes, how many students are in neither class? How many are in either class? What is the probability that a randomly-chosen student from this group is taking only the Chemistry class?

  There are two classifications in this universe: English students and Chemistry students.

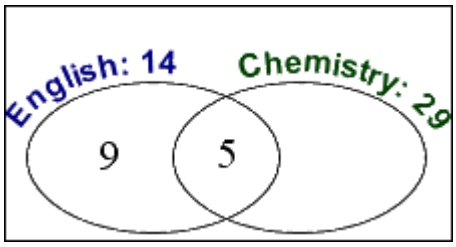
  First I'll draw my universe for the forty students, with two overlapping circles labelled with the total in each:



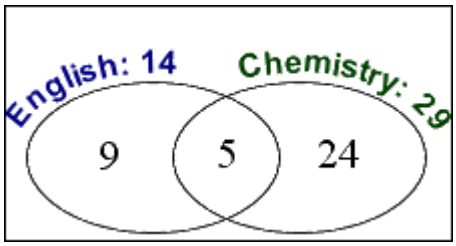
Since five students are taking both classes, I'll put "5" in the overlap:



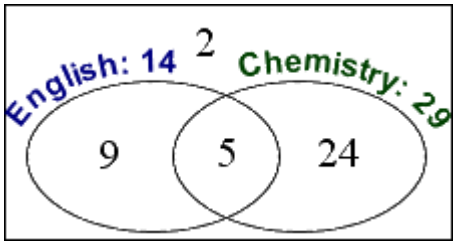
I've now accounted for five of the 14English students, leaving nine students taking English but not Chemistry, so I'll put "9" in the "English only" part of the "English" circle:



I've also accounted for five of the 29Chemistry students, leaving 24 students taking Chemistry but not English, so I'll put "24" in the "Chemistry only" part of the "Chemistry" circle:



This tells me that a total of 9 + 5 + 24 = 38 students are in either English or Chemistry (or both). This leaves two students unaccounted for, so they must be the ones taking neither class.



From this populated Venn diagram, I can get the answers to the questions.

Two students are taking neither class.
There are 38 students in at least one of the classes.
There is a 24/40 = 0.6 = 60% probability that a randomly-chosen student in this group is taking Chemistry but not English.

4. Choosing the Calculation Method:

When solving a problem you must choose which calculation method is the best to use. Do you have to use 'mental math' or pen and paper or calculator? This is at your discretion unless instruction tells you a specific method.
Hints:

1 First try mental math

2 Look for easy computations
3 Then choose paper and pen or a calculator
4 Better to use a calculator when many steps are needed.

5. Problems with More than One answer:

When you get an answer to an open - ended problem do not stop there but test to see which of the many answers the required one is. It could be that your answer is restricted to a certain range so you use the range as a way of eliminating the other answers.

Given that **A>90°**, If **cos A = 0.5** find the angle A.
The possible values of the angle are **60°**and **300°**
But, we are given a range hence only **300°** is within range and **60°**is not.

6. Deciding when to Estimate

If you get an answer like 'two and a half people' then obviously you are supposed to 'round off' to suit the problem at hand. An Olympic athlete will be interested in the exact record time including micro seconds, so he or she can fully prepare. You should be able to identify situations where you need to be exact and when you need to round off or estimate. For example, you cannot give an exact number of people who are going to die next week, the amount of rain that will pour tomorrow, but estimations are the way out.

7. Using Data from a Chart

As indicated before, charts and diagrams in general serve as pictorial aids to understanding the problem. It is important that you be able to extract information from it and use it to your benefit. For example in 'histograms' and 'bar graphs' the bar with the tallest height has got the 'highest frequency'. In a pie chart the sector with the widest angle implies that it has the highest frequency. With this ability of extracting information you can then proceed to make reasonable deductions and conclusions.

Example:

A survey was conducted to determine the performance in mathematics for learners residing in Tembisa. 25 learners were asked their mathematics symbol for the previous term. The following list shows the responses:

C C A B D E E D DD E C C A C D E A A B BB C C D

i.) Draw a frequency table and record the results.

ii.) Use the information on the frequency table to draw up a vertical bar graph.

iii.) Using the information gathered, construct a pie – chart to illustrate

these results.

iv.) What can you conclude about the mathematics performance of learners in Tembisa?

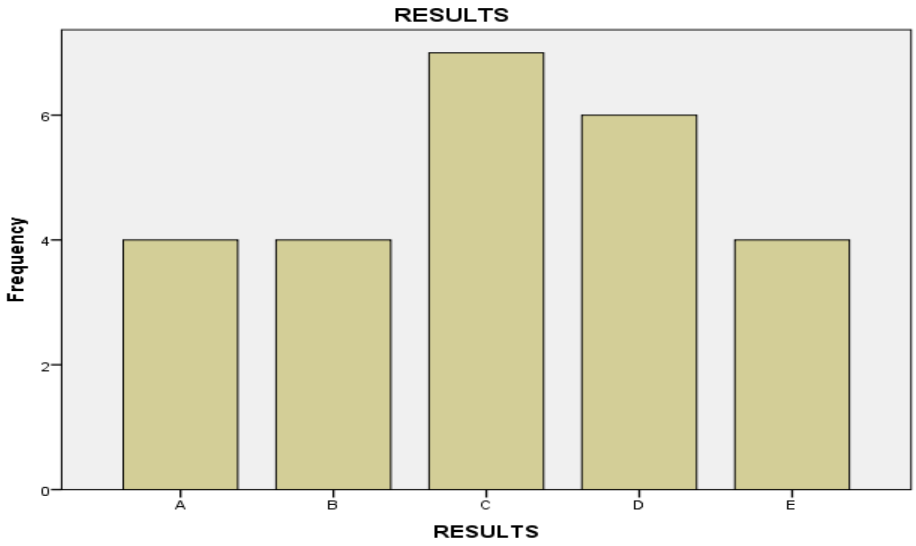
Solution:

RESULTS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A	4	16.0	16.0	16.0
	B	4	16.0	16.0	32.0
	C	7	28.0	28.0	60.0
	D	6	24.0	24.0	84.0
	E	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

The results can be shown in a table format from the table the data has been represented to give us a quick-view of what transpired. From the results it shows that the modal symbol is C. If C and above are the pass symbols then 60% of the learners passed.

FIGURE8-4: ILLUSTRATION OF RESULTS USING PIE-CHART

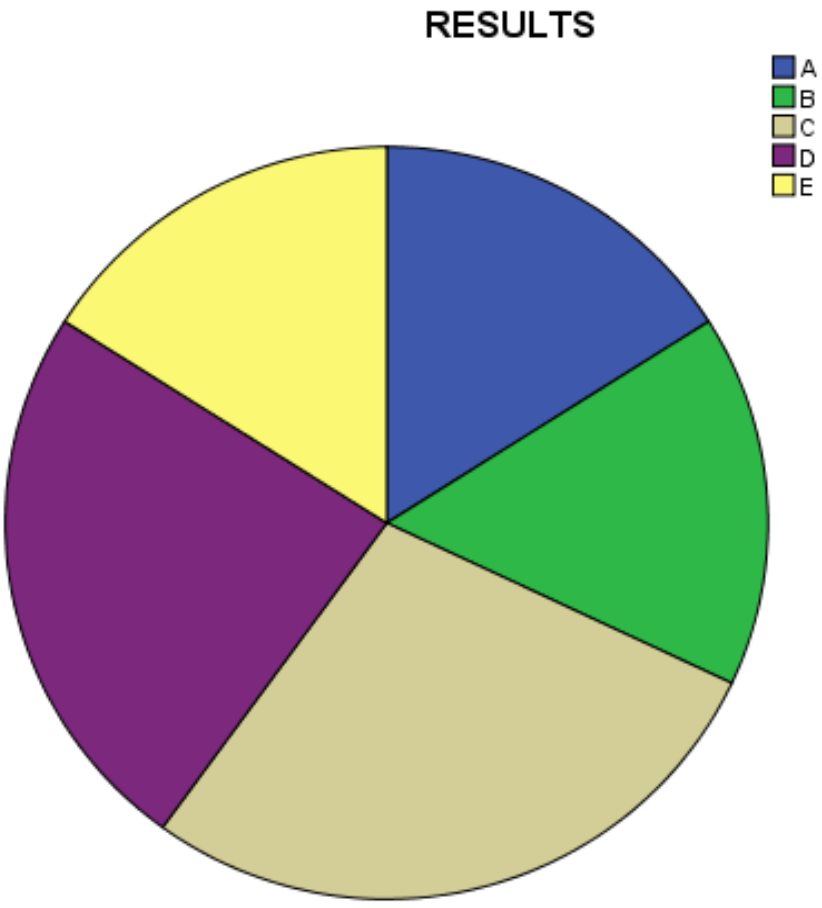


The information in the table can be represented in a bar graph format as illustrated above.

iii) Figure 8-5: TABLE OF RESULTS OF SURVEY

SYMBOL	FREQUENCY	FRACTION	PERCENTAGE	ANGLE
A	4	0.16	16%	57.6°
B	4	0.16	16%	57.6°
C	7	0.28	28%	100.8°
D	6	0.24	24%	86.4°
E	4	0.16	16%	57.6°
TOTAL	25	1.00	100%	360°

FIGURE8-6:ILLUSTRATION OF RESULTS USING PIE-CHART



iv.) I can conclude that most of the children in Tembisa were average or above average because 60% of the learners obtained symbol C or better.

Work Backwards

This is an ability that will help you in problem solving. Some tend to call it “reverse-engineering” This will work when you know what you want to achieve and you also know what tools you have at your disposal to get to the objective. In the present world the Chinese are well known for this kind of creativity, they can ‘reverse-engineer’ any product and come up with an improved version of it. The idea behind this thought process is that of undoing the key actions in the problem.

Example:

The palace kitchen staff brought in 4 pies left over from the feast. 12 pies were eaten at the feast. The Chief took 2 home with him. How many pies did the servants bring into the feast at the beginning?

This problem entails working backwards with respect to time. We will start with the last actions until we reach the initial one which is that of bringing pies to the feast.

Palace staff brought 4 pies from the feast (not to the feast).

The Chief took 2 pies home after the feast.12 pies were eaten at the feast. To get the initial number of pies we have to add all the pies:

4 + 2 + 12 = 18

Therefore 18 pies were brought to the feast.

N/B: Do not look at the question and say it was easy but rather focus on the thought process because it will help you with more challenging problems.

8. Guess and Check

Example:

Charmaine divided 15 plastic balls into two piles. She named the two piles: Charmaine's balls and Lisle’s balls. Charmaine owns 3 more balls than Lisle. How many balls does Lisle own?

Two numbers which when added together give 15 and their difference is 3 are 9 and 6. Hence, Lisle has 6 balls.

Now let us check to see if this is the answer.
Let x be Charmaine's balls, so Lisle’s balls will be x – 3 Adding the two expressions gives a total of 15.

x + x - 3 =
15 2x - 3 =
15 2x = 15
+ 3 2x = 18

Therefore x = 9 (Charmaine's balls)

And Lisle's balls = x – 3 = 9 – 3 = 6 balls.
We have proven our guess to be true. OR,

Lisle's = x and Charmaine's = x + 3

Such that 2x + 3 = 15
This implies that 2x = 12
Therefore x = 6.This is the number of Lisle's balls.

9. Look for a Pattern

In any problem you should check how the pieces of information are connected by a pattern. In mathematics, there are so many patterns and it is your duty to recognize them. They range from fascinating sequences like the Fibonacci sequence, Pascal's triangle...When looking at the patterns and sequences you should try and see if they will diverge or converge to a single number although this will not always be necessary unless stated.

In real life, there are so many examples of patterns that you can see. For example weather patterns, floor tiles, roof trusses among others. Identifying patterns helps in making predictions and forecasts which is essential for strategic planning.

Let us look at the following example.

Katlego arranged loaves of bread on 7 racks in a delivery van. He put 1 loaf on the bottom rack, 5 on the second rack, 9 on the third rack. If he continues this pattern, how many loaves did Katlego put on the sixth and seventh racks? The pattern is like this:

1; 5; 9; …

If you take a look you will see that each term is generated by adding 4 to the preceding term. For us to be in a position to find the sixth and seventh terms we have to continue the pattern like this:

1; 5; 9; 13; 17; 21; 25; 29, …

The sixth and seventh terms are 21 and 25 respectively.

After recognizing the pattern and seeing that 4 is being added to each term ,then you will have recognized that this is an arithmetic progression with 4 as the common difference d.
The first term a is 1.
Given that n is a natural number
The nth term is given by the formula a_n =a + [n-1]d Sixth term is a_6 = 1 + [6 – 1]4 = 21 loaves
Seventh term is a_7 = 1 + [7 – 1]4 = 25 loaves. Using

this method you can predict other terms.

Draw a Picture

As the saying goes "A picture is worth a thousand words, " this is particularly true in math problems especially with word sums. Pictures clarify seemingly difficult problems; so, make it a habit to draw pictures wherever possible.

Example

A frog is at the bottom of a 10-meter well. Each day he climbs up 3 meters. Each night he slides down 1 meter. On what day will he reach the top of the well and escape?

Solving Growing Pattern- type Problems

Now let us give you the general way of looking at a problem where you can see a pattern. This is just an extension of section (i) above. This general method is according to the Cheshire County Council (Cheshire County Council Educational Services)

a**.) Generalization**: In a generalisation, you should be able to:

- Generate a typical example
- Classify and order them systematically
- Recognize and extend the pattern or relationship
- Express the relationship in general terms ,algebraically or verbally

b**.) Proof**: To show proofs follow these steps:

- Check all possible cases
- Identify the underlying relationship connect the data and reach a conclusion

c**.) Representation**: A representation involves the use of:

- Methods such as tables and graphs for diagrammatic recording.
- Algebraic symbolism.

CHAPTER NINE

Problem Solving Through

Puzzles and Games.

"A great discovery solves a great problem, but there is a grain of discovery
in the solution of any problem. Your problem may be modest, but if it challenges your curiosity
and brings into play your inventive faculties, and if you solve it by your own means, you may
experience the tension and enjoy
the triumph of discovery."
– George Polya (1887 – 1985) Hungarian mathematician

"Innovation and creativity have to be more than vague aspirations .They must become codes written in your DNA" – Anonymous

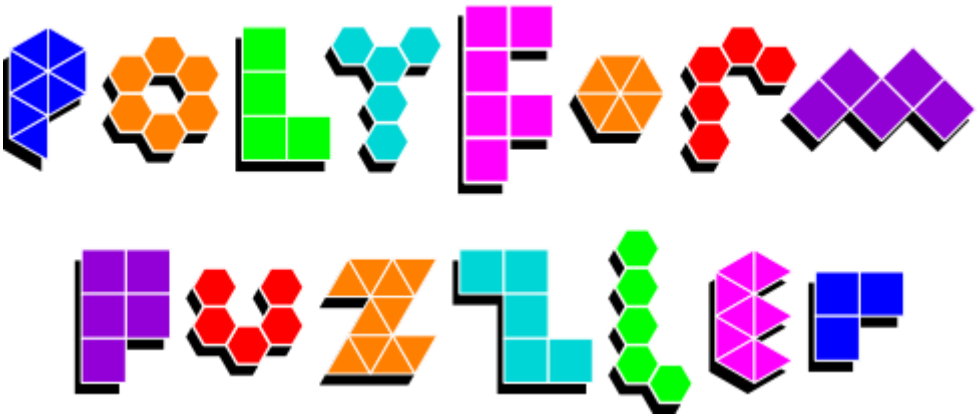
Math Concepts and Fun Games

It is imperative that you play '*strategy games*' that will enhance your math skills. This is different from a class situation, because the main aim is enjoyment and fun, although you learn a lot in the process. Thus is different from a class where your main aim is to learn and maybe enjoy the lesson if you choose to.

Puzzles require you to explore and unearth the hidden solution. This is also the essence of mathematics. The idea of puzzles is that you have to apply all your intuition, creative thought, ingenuity, exposition skills to come up with the answer.

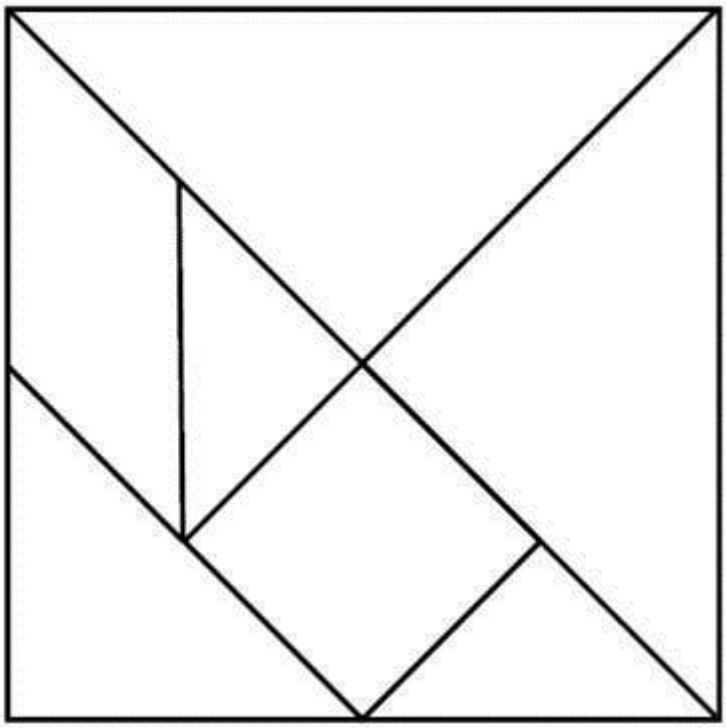
Strategy puzzles that you can utilize:

Pentominoes:



These are 5 squares orthogonally connected to each other and can be used filling boxes, tiling rectangles, video games etc. More information can be found on puzzler.sourceforge.net/docs/pentominoes.html

Tangrams:

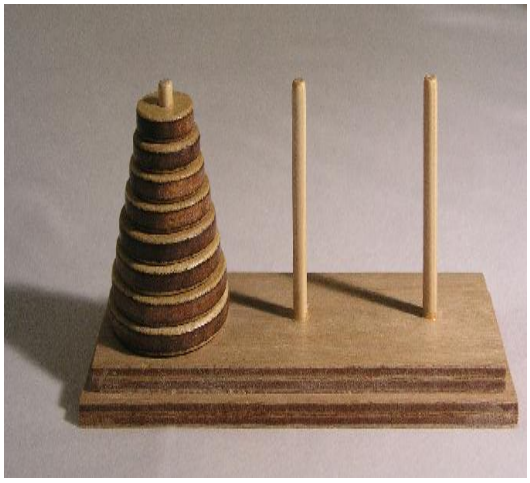


Consists of 7 flat shapes which are used to construct shapes.

Rubik's cubes:

Rubik's cubes are very common and sold everywhere. This cube as has been used to demonstrate genius as illustrated in the movie In Pursuit of Happyness starring Will Smith.

Tower of Hanoi:



Favourite game for monks and programmers. The objective of the puzzle is to move the entire stack to another rod, obeying the following rules:

- Only one disk may be moved at a time.
- Each move consists of taking the upper disk from one of the rods and sliding it onto another rod, on top of the other disks that may already be present on that rod.
- No disk may be placed on top of a smaller disk.

With three disks, the puzzle can be solved in seven moves.

Sudoku (means single number):

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

This puzzle has gained popularity worldwide. It has been played in Japan for almost twenty-one years. This is a puzzle which is based on logical number placements. The challenge is to fill the 9 x 9 grid without repeating a digit in a particular row or column, at the same time the digits 1 to 9 have to be represented once in each 3 x 3 grid.
So, these are the two objectives. It takes a lot of analysis to come up with a comprehensive solution. The puzzles come with varying levels of difficulty ranging from very easy to very challenging. Sudoku is available in most newspapers and magazines worldwide.

Chess:

Chess is a game played on a squared chessboard, with sixty-four squares of alternating black and white colours. When play commences each player has a set of chess pieces, all of one colour (white and black).A set consists of sixteen pieces namely, one king, one queen, two rooks, two knights, two bishops and eight pawns.

The aim of the game is to attack the opponent's king in such a way that the next move of the king is still under attack, this is termed as '*checkmate*'.

Chess is played by two opponents, sometimes you can play against a computer. Many people play chess professionally and it is one of the fastest growing forms of sport in the world. Start playing chess and you will amass a lot of problem solving skills.

Other games that you can consider are:

- Tavern Puzzles: horseshoe and other interlocking chain type puzzles
- Wooden Barrel and other 3D interlocking puzzles.
- Twisted Nail type puzzles
- Strategy games such as Mastermind and Monopoly.
- Peg Solitaire (Hi-Q)

Once you appreciate the role played by these games in moulding you to be a mathematical genius, you will be hooked on to them for a greater good. There is nothing to lose in trying out these games, after all, you will be enjoying.

Exercise:

Solve the Sudoku puzzle below.

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

"Consider yourself a genius and act like one in every moment of your life and you will very soon feel that you are one." - Jim Westergren.

CHAPTER TEN

HOW TO PREPARE FOR TESTS AND EXAMINATIONS

Math is essentially a DOING subject where you are supposed to solve problems.
Efficiency and ability in solving problems is a guarantee for success in learning this subject

Preparation for Examinations and Tests

This chapter is dedicated to effective study to ensure success in the tests and examinations. It does not contain quick fix solutions to long term problems but a systematic way of attaining a pass in mathematics. It is not good to wait for the last minute and memorize formulas which you do not fully understand. This implies that preparation for exams starts on the first day of school. It is an on-going process which will be beneficial to you in the end because you will intimately know your math and in the workplace you will be an asset of great value. Before I go into the details of this chapter, let us look at a survey that was conducted in 2007 to verify the quality of students that are going to different universities and companies in South Africa.

Results of Survey Circulated to Universities and Employers of the Competence of Young People that have emerged from Education System up to 2007

(*Survey by Jonathan Jansen released Jan 2008)*

Universities and employers complained that although young people emerged from the education system with amazing Matric symbols the following foundational skills were so lacking that both university entrants and new employees had to be sent on bridging courses before they were able to cope in their new environment: Lacking Skills

1 Reading Competence
2 Writing Accuracy
3 Ability to speak fluently
4 Basic Numeracy
5 Ability to interpret graphs
6 Basic computer literacy
7 Capacity to do basic bibliographic searches
8 Functioning within diverse teams
9 Solving both simple and complex problems

Both the universities and employers alike were unanimous when it came to the recognition of the lack of the following attitudinal attributes:

1 Perseverance
2 Confidence
3 Integrity
4 Discipline
5 Determination

It was suggested that South African Learners are being "dumbed down" by memorizing meaningless knowledge, regurgitating archaic facts and formula and cramming for exams. All this at the expense of basic skills necessary and sufficient for a growing economy in the 21st Century.

From this survey, it is clear that employers and institutions of higher learning are not too impressed by the quality of student and employee they are getting. You should make it a point not to be a statistic of incompetence.

It has been stressed in preceding chapters that having the right attitude and mind-set is key to success. Therefore success, itself is a result of proper management of your thought process thereby improving positive attributes across the board. Work towards removing all the bad and unproductive habits that you are aware of. Tips on how to make the most of your studying
and learning:

Tips on Enhancing Your Studies and Learning

For these tips to bear fruit, start on the first day of school.

1 Engage in active study (Always get a pen and paper and actively work out problems in the process of understanding)
2 Take responsibility for studying, recognizing what you do and do not know, and knowing how to get your teacher to help you with what you do not know.
3 Attend class every day and do your work diligently. Teachers formulate test questions from work that has been covered as examples and exercises and from the text book.
4 Be an active participant in class. Get ahead in the textbook, try to work out some of the problems even before doing them in class-provided you have understood the covered topics. Anticipate the teacher's next step.
5 Ask questions in class. There are other learners wanting to know the answers to the same questions you have. So do not be afraid of being mocked.

6 Reassure yourself each and every day that you can make it, no matter how rough the road maybe.
7 Math is a doing subject. Do your homework, classwork, projects, investigations and other assignments to the best of your ability. (The more the problems you solve, the better you learn the necessary formulae and techniques as well as improve your problem - solving prowess.)
8 Math is a cumulative subject so make it a point to always revise work that you already covered because it will be linked to whatever topic you will be doing (even the easy things that you have mastered).
9 Identifying and learning the fundamentals (basic key concepts and principles) means that you do not have to memorize.

10 Form a study group. Get help with problems and also teach others what you understand. Teaching others is one of the best ways to understand and retain knowledge.
11 The more challenging the material, the more time you devote to it.
12 Have a study time table that will help you with self - organization.

"The true genius knows that it is not enough for only him having reached the sky high levels – he has to take the rest of mankind with him up and has dedicated his life in making it happen." - Jim Westergren

These tips constitute good study habits and are key to your success. In the next chapter we will look at my favourite number phi (1.618…).This will illustrate the elegance, beauty and relevance of math in our daily lives.

CHAPTER ELEVEN

THE GOLDEN RATIO

"Our deepest fear is not that we are inadequate Our deepest fear is that we are powerful beyond measure It is our light not our darkness, that most frightens us

We ask ourselves "Who am I to be brilliant, gorgeous, talented, fabulous?" Actually, who are you not to be?

You are a child of God. Your playing small does not service the world There is nothing enlightened about shrinking So that other people won't feel insecure around you

We are born to manifest the glory of God that is within us It is not just in some of us - It's in everyone and as we let our light shine, We consciously give other people the permission to do the same As we are liberated from our own fear, Our presence automatically liberates others."- (Marianne Williamson, A Return to love)

- Popularised by Nelson Mandela

The Divine Proportion

"The pervasive appearance of Phi throughout life and the universe is believed by some to be the signature of God, a universal constant of design used to assure the beauty and unity of His creation." – (Rajesh Warrier.)

Background to Phi

Phi = 1.618… This irrational number has fascinated mathematicians and non-mathematicians alike for centuries. Many acclaimed individuals who knew about this fine ratio made use of it and created or produced work that was of high quality and has transcended age. Some of their works have been declared perfect because they incorporated the number of perfection in their work. Phi is found in many areas of life. Its presence is very distinct in design, architecture, geometry, beauty, cosmology, nature, stock markets, religion… the list continues. Before looking at the existence of Phi in the various spheres of life, let us look at its history.

Phi has always been there but it can be credited to Euclid, when he wrote in 'The Elements'. He listed a lot of propositions, and the one we are interested in is one where he proposed what he termed '*The mean and extreme Ratios.'*

Euclid proposed that If there exists a line AB, such that there is a point D on line AB, with AD shorter than DB, then AD ÷ DB = DB ÷ AB as shown in the diagram displayed below.

Figure 11-1: MEAN AND EXTREME RATIOS

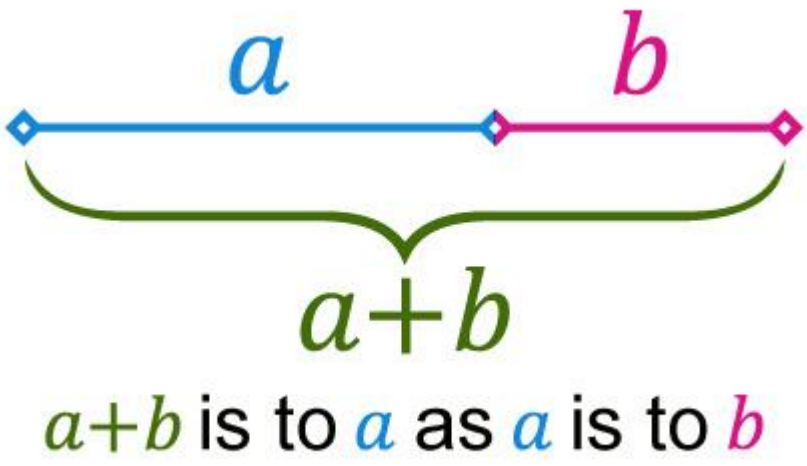


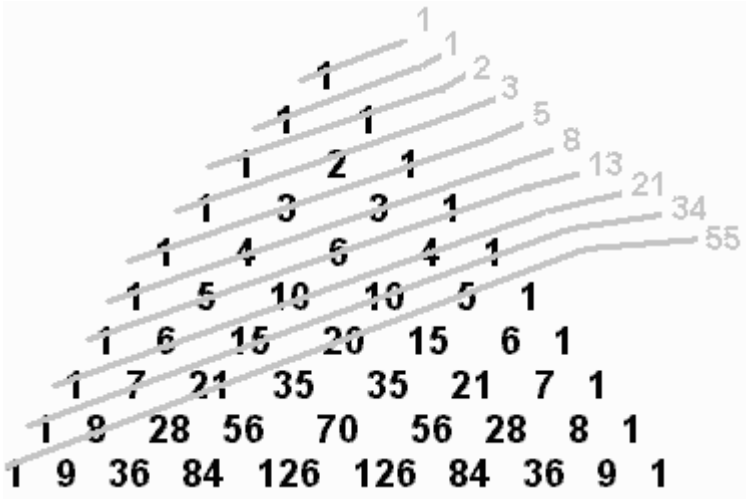
Figure 11-1: MEAN AND EXTREME RATIOS

Now there is a sequence credited to an Italian mathematician called Leonardo Fibonacci which helped understand Phi. This sequence converges to Phi as we approach infinity. The sequence is generated by adding the two preceding terms to get the next term. The sequence looks like this:

0,1,1,2,3,5,8,13,21,34,55…

What is happening is this:

Figure 11-2: FIBONACCI SEQUENCE



0 + 1 = 1; 1 + 1 = 2; 1 + 2 = 3; 2 + 3 = 5…etc.

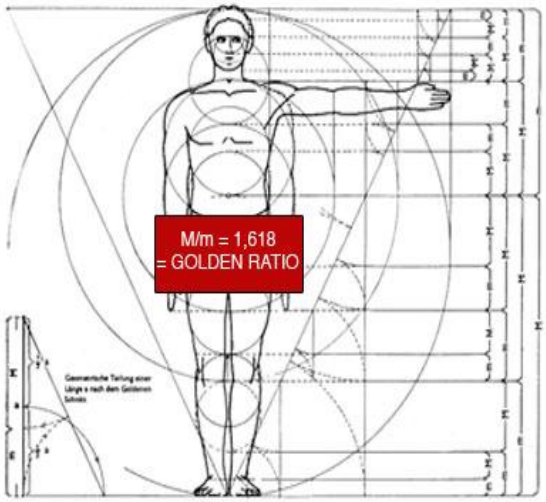
Using this sequence we see that dividing the **(n + 1)th** term by the **nth** term, as the value of **n** increases the ratio approaches Phi hence the sequence converges at Phi.

(n + 1) th term ÷ nth term = 1.618…

Let us now consider Phi in the various aspects of life. This is a fascinating exposition of this ratio that has been given a lot of names.

It has been called *The Divine Proportion, God's Number, Golden Ratio/Section, The Number of Perfection, The Number of Beauty, and The Phinest Number*. What is the reason for all these names? Let us find out.

Phi in Human Beings:

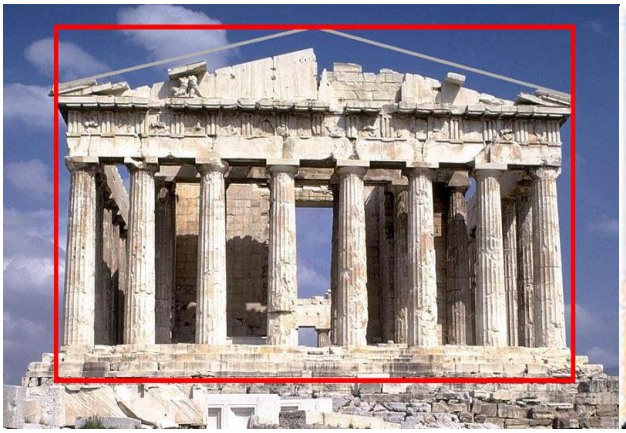


The human body fundamentally comprises of building blocks whose proportions equal Phi. Looking at the human body the golden ratio can be noted everywhere. The longer distance is divided by the shorter distance to give a ratio of 1.618...which is Phi. Here are few examples out of the many Phi ratios:

1. Length of middle finger to length of the little finger.
2. Length of face to width of face.
3. Distance between pupils to distance between eyebrows.
4. Height of human being to distance from belly button to the foot.
5. Distance between shoulder line and the top of the head to the length of the head.

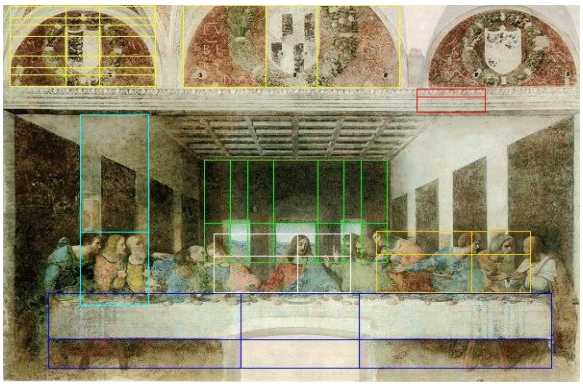
We will have to stop because we could never exhaust the ratios that yield '*Phi*', in actual fact this ratio requires volumes of books on its own.

Phi in Design, Architecture and Geometry:



The ratio '*Phi*' crops up in many architectural structures such as The Pyramids of Egypt, United Nations Building in New York among others.
Phidias (500-432BC) a Greek sculptor and mathematician studied Phi and used it in designing the Parthenon in Greece. There are so many monuments where Phi has been noted and it has fascinated mathematicians for a very long time.

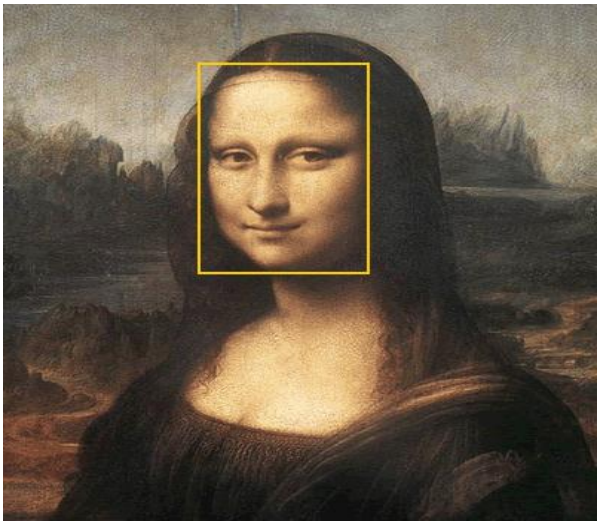
Religion and Cosmology



The painting by Leonardo Da Vinci of '*The Last Supper*' is one of the most significant applications of Phi in religious circles. The table, wall and windows on the painting all exhibit Phi. Plato (428-347BC) considered the golden section to be the key to the physics of cosmos, which Johannes Kepler (1571-1630) agreed to when he discovered the elliptical nature of the orbits of the planets around the sun.

Some mathematicians have also linked the number 666 to Phi. Euclid was able to expose the presence of Phi in the pentagram, which is the shape of David's star. Saturn's magnificent rings show a division at a golden section of the width of the rings.

Phi in Art



Many artists from the Renaissance period identified '*Phi*' as the factor responsible for beauty hence they used it extensively in their paintings and sculptures.

The Mona Lisa is one of the most expensive and most sought after paintings of all times. The face of Mona Lisa has all the ratios coming exactly to '*Phi*'.

Many people are using Phi to their advantage on a day to day basis knowingly and unknowingly. Plastic surgeons use '*Phi*' to beautify people.

The stock markets have seen a lot of the ratio. We can never finish all there is to talk about Phi which is why it is the most fascinating number in existence. These few examples show us how 'Phi' is found in all areas of life hence the need to study it in depth.

CHAPTER TWELVE

CONCLUSION

"That which we persist in doing becomes easier -
not that the nature of the task
has changed, but our ability to do has increased." –Ralph
Waldo Emerson.

Much has been said about changing your mindset and becoming the person who you want to be. This change is never going to occur by merely reading this book and expect a miracle to happen. Application of these principles is the only key. You are the key - bearer of your success, if you permit yourself to be committed, then you will have the strength and endurance to fight all the way through until you achieve.

A man called Sadat once said "*He who cannot change the very fabric of his thought will never be able to change reality, and will never therefore, make any progress."* This is particularly true in math context, where self-confidence and self-discipline will get you to that point where you can tackle any given problem. You become such a prolific problem solver that you are assured of becoming a mathematical genius.

You can attain excellence if you work towards it whole heartedly with the intensity necessary and sufficient to guarantee it.

Today is the day to start, don't wait for tomorrow because it might be too late. Start writing the book of your life today, no-one is ever going to that for you but yourself. This was well put by the musician by the name of Natasha Beddingfield in her song '*Unwritten*', she had this to say:

"Feel the rain on your skin, No-one
else can feel it for you, Only you can
let it in,
No-one else, no-one else,
Can speak the words on your lips, Treat
yourself to words unspoken, Live your
life with arms wide open,
Today, is where your book begins, the rest is still unwritten."

You are the one who knows how badly you want to succeed in math, you are the only one who can surely feel the rain on your skin.

It calls for innovation, creativity in your study habits so that you don't get tired and bored. Be open-minded, that is live life with arms wide open, it will surely broaden your horizons. At the end, what is your book going to be? What will people remember about you? What will you think of yourself?

Start now, take action and embark on this fulfilling mathematical journey. You are a mathematical genius if you choose to be and work towards it.

GLOSSARY

Algebra: branch of mathematics that uses letters etc to represent numbers and quantities.

Analogy: arguing or reasoning from parallel cases.

Coordinate: this is the address of a point on a Cartesian plane.

Electromagnetism: the study of magnetic forces produced by electricity.

Equation: a statement that two expressions are equal.

Estimate: rough guess at the value of a number.

Fibonacci number: a member of the sequence 0, 1, 1, 2, 3, 5… where each number is the sum of the previous two numbers.

Formula: a concise statement expressing the symbolic relationship between two or more variables.

Frequency: the number of times a value occurs in some time interval.

Geometry: the branch of mathematics that deals with the nature of space and the size, shape and other properties of figures as well as transformations that preserve these properties.

Golden ratio: (1 + sqrt(5)) ÷ 2

Histogram: statistical diagram of rectangular areas proportional to the value of a number of variables.

Irrational numbers: numbers that is not commensurate with the natural numbers.

Like terms: terms in an algebraic expression or equation that has identical variables.

Logic: a science of reasoning.

Natural number: whole number greater than zero. (Counting number)

Numerical: of or relating to a number or numbers.

Pascal's triangle: a triangular array of binomial coefficients.

Phi: twenty – first letter of the Greek alphabet (Ö,ö)

Pie – chart: a type of chart in which a circle is divided up into portions in which the area of each portion represents the size of the data.

Proof: step by step resolution of a mathematical or philosophical problem.

Puzzle: problem or toy designed to test knowledge or ingenuity.

Quantum Physics: physics theory assuming that energy exists in discrete units.

Quotient: result of a division sum.

Ratio: quotient of two numbers.

Rational numbers: expressible as a ratio of whole numbers.

Sets: a collection of objects.

Statistics: science of collecting and analysing numerical data.

The Elements: mathematical book written by Euclid which contains many propositions.

Theory of relativity: physics theory based on the principle that all motion is relative and that light has constant velocity.

Trigonometry: branch of mathematics dealing with the relations of the sides and angles of triangles and with the relevant functions of any angles.

Variable: a symbol whose value can change.

Venn – diagram: diagram using overlapping and intersecting circles to show the relationships between mathematical sets.

Word problems: a mathematical problem that has a story which must be In order to solve it.

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