

The NSSC Mathematics (ordinary level) syllabus, core and extended

The localisation of Mathematics and the reasons for the adjustments to the syllabus

From 1995 to 2005, IGCSE Mathematics made provision for Namibian learners and students to study the core component of the syllabus, or to study the whole, the extended component of the syllabus. These two levels have been retained in the new NSSC Mathematics (ordinary level) syllabus. Many subjects have done away with this distinction; Mathematics has *fortunately* retained it. If this had not been so, Mathematics would have been put beyond the reach of our Grade 11 and 12 learners who are capable of studying Mathematics at the core level, but not at the extended level.

It is stated very clearly in Namibia’s *Vision 2030* that Namibians are to become mathematically empowered. Everyone should become confident about using numbers and be able to use numbers with understanding in their private and professional lives. The core level of the syllabus aims to provide for this need to ensure that every person can become numerate. *For this reason, the teacher who teaches the core component of the syllabus, with the intention of bringing mathematical insight to learners, is doing an extremely important task; he or she is empowering the youth of our nation and of working towards achieving this aim as expressed in Vision 2030.*

At the core level, nothing has been removed from the previous syllabus and two small sections have been added, one in the topic of ratio and proportion, and the other on the solution of equations.

At the extended level, a great deal has been added, much of this is pure mathematics, mostly algebra. The reason is closely linked to the Namibian situation. The University of Namibia (UNAM) as well as the Polytechnic of Namibia require or favour a pass in Mathematics at the extended level, from prospective students of engineering, technology and the natural sciences. The added topics will assist students immensely in their studies at tertiary level. These changes also address a goal expressed in *Vision 2030*: by 2030 there needs to be a workforce of qualified Namibians who are able to apply mathematical knowledge to science and technology.

The changes to the extended level of the syllabus were made with our Namibian learners in mind, particularly those who are at schools in Namibia that do not offer the higher level of Mathematics yet, but who aim to study further after completing their schooling. This enriched extended course will enable them to fulfil their mathematics potential and stand them in good stead at tertiary level.

There is no doubt, when one looks at world trends, that mathematics is important and must be given priority in education. In line with such thinking, the localised Mathematics syllabus aims to equip Namibian students and learners more effectively with meaningful mathematical knowledge and understanding.

The changes that were made to the syllabus content

The tables that follow are very important for teachers who use questions from past examination papers, particularly papers that date back to before the localisation of the syllabuses. These tables indicate which questions should not be included, and also which topics were not covered in previous examination papers because they did not form part of the IGCSE syllabus.

Core syllabus

At core level, two new topics were added.

Core syllabus: topics that have been added to the syllabus		
Topics added	Detail	Reasons
Ratio and proportion	Increase and decrease in a given proportion	Percentage increase and decrease is prescribed, this addition forms a natural extension of the topic.
Solution of equations	The solution of quadratic equations that are given in factorised form	The addition of this concept widens the core learner’s understanding of the solution of equations.

No topics were removed from the core level.

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Topics that were added to algebra at the extended level are listed in the table.

Extended syllabus: topics that have been added to the syllabus	
Details	Reasons
	The topic was added:
Coordinate geometry	to enrich the extended level with knowledge that was previously prescribed for the higher level only; to enrich the course with a section of mathematics that entails algebra, graphs and geometry
Polynomials	to enrich the extended level with knowledge that was previously prescribed for the higher level only
Writing a quadratic expression in the form $a(x + p)^2 + q$	to enrich the learners’ understanding of quadratic expressions, functions and graphs and, thus, empower them
The application of index laws to simplify expressions and solve exponential equations	as above, for important enrichment in preparation for further study
Laws of logarithms and their application to simplify expressions and solve equations of the form $ax = b$, logarithms to the base 10 only	as it is a very important topic for further study
Arithmetic and geometric sequences, the formulae for the n th term, the sum to n terms	for enrichment and expansion of algebraicknowledge (it was previously a higher Mathematics topic)

Topics that were removed from the extended level are given in the table.

Extended syllabus: topics that have been removed from the syllabus	
Topics removed	Reasons
Sets	Room had to be made for the topics that were added (listed above); these topics were considered to be the most suitable to be removed, as they are not prerequisites for other topics
Matrices	
Shear and stretch transformations	
Symmetry in solids	

Who should study the core syllabus and who should study the extended syllabus?

It is extremely important that learners are registered for the correct option, core or extended. If a learner is registered for the extended syllabus and does not belong at that level, the learner’s results will not reflect his or her true potential and will, in all probability, lead to him or her being ungraded in the final examination. Learners who obtains less than an E symbol for the extended syllabus for Mathematics, will have the ungraded symbol, U, on their certificates. It is most appropriate that learners who are A or B candidates in Mathematics, register for the extended level.

Learners who intend to study at the tertiary level (university, college or technikon) after Grade 12, who have achieved a good symbol in their Grade 10 examination for Mathematics, who love Mathematics and who are an independent and diligent workers, should attempt the extended level.

A good symbol for Mathematics in Grade 10, means having achieved an A or a B symbol for Grade 10 Additional Mathematics. It may be that learners have come from schools where Additional Mathematics was not offered in Grade 10. Such learners who achieve an A for Mathematics at the ordinary level in Grade 10, may have the ability to manage Mathematics at the ordinary level for the extended syllabus, and should be given the opportunity to try to do so. It is, however, not a guarantee that they will be successful, as many such learners (those who achieved A symbols for ordinary level Mathematics in Grade 10) have, in the past, not been successful at the extended level work. Fortunately, there is lots of time, as this is a two-year course, and registration for the final examination only takes place in March or April of the second year of the course – in Grade 12. The teacher, therefore, has time to cover a great deal of the syllabus and to let the learners write a few representative internal examinations before the registration for the final examination takes place. The results of these internal examinations should give a true indication of the appropriate level at which a learner should register for Mathematics – core or extended.

The syllabus: in the teacher’s hand at all times

The teacher must ensure that that he or she has a copy of the new syllabus. The date on the front cover of the syllabus should read “For Implementation in 2006” and “For First Examination in 2007”. If an even more recent version than the 2006/2007 one is available, that will be even better. Do not use any syllabus that is older than the 2006/2007 one.

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Teachers should not store the syllabus in a file or let it gather dust! It should be kept at hand. *It contains all the information that the teacher needs to be able to guide the learners correctly:*

- the learning content/subject matter for the core level
- the learning content/subject matter for the extended level
- the assessment objectives
- a description of the examination papers
- the aims of teaching Mathematics.

The syllabus is the tool teachers use to draw up their schemes of work and do their planning. Without using the syllabus, no teacher can feel confident that he or she has planned responsibly.

When reading the syllabus, note that the extended content is printed in *italics* and everything else (including the core content) is printed in regular font. The extended candidates study the *whole* syllabus, the core as well as the extended components. The sections printed in italics are intended *only* for candidates who follow the extended syllabus.

A work plan for the core level of the syllabus

The core section of the syllabus is manageable, in terms of the time available to teach it. Furthermore, and very importantly, much of this content has been taught before, in Grades 8, 9 and much of it in Grade 10. Some of this content, such as common fractions, has been taught since junior school. However, some topics have been taught only once before, in Grade 9 or 10, and so they could be taught again, if necessary.

Teachers need to decide whether to start at the beginning of the syllabus, and teach the topics in the given order, or not. It may be interesting and stimulating to start a new year with a few topics with which learners have not worked previously.

In the table on the next page, all new and fairly new topics, are listed. The topics should receive prime teaching time and attention.

New topics in the core syllabus			
Topic numbers	Specific objectives	Topics	Revision or new
1(a)	1	irrational numbers	revision
1(i)	1, 2	limits of accuracy	new
1(j)	5	increase or decrease a quantity in a given ratio	new
3(a)	1	volume of a prism	new
4(d)	1–7	angle properties, reasons must be given	new
4(e)	1–4	locus	new
5(a)	4	transforming simple formulae	new
	5	constructing linear equations	revision
5(d)	1	solving simple linear equations	revision
	2	solving two simultaneous linear equations	new
	3	solving quadratic equations that are given in factorised form	new
5(e)	1	recognising patterns in sequences	revision
5(e)	2	finding the n th term in a linear sequence	new
6(b)	1	linear programming	new
6(d)	1	constructing tables of values for functions of three different forms	new and revision
	2	plotting and drawing the graphs of those functions	new and revision
	3	finding the gradient of a straight line graph	revision
	4	Solving linear and quadratic equations approximately, by graphical methods	new
8(a)	1, 2, 3	trigonometry	new
9(a)	1, 2, 3, 4	vectors	new
9(b)	4	translations	new
10(b)	1, 2, 3, 4, 5	probability	new

Read the table of contents in the syllabus to see where the topics in the table above are listed. Work out which topics have been omitted from the table so that you can become familiar with your syllabus as soon as possible.

Then draw up a year plan that will set out in broad terms what you hope to cover in each of the two years. Remember that the final external examination is written in October. You, therefore, need to aim to complete teaching the topics by July of the Grade 12 year. This will allow time for an internal preliminary examination, as well as for feedback, and last-minute matters that result from that examination. This means that teaching the syllabus content must be completed in 18 months.

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Consider the broad guidelines below when drawing up a scheme of work for the extended level.

Core level: guidelines for drawing up a scheme of work			
Teaching time	Syllabus references	Topics	Approximate percentage of syllabus content
Grade 11 Trimester 1	1, 2, 3, and 4(a) and 4(b)	Numbers and operations Measures Mensuration Geometry	30% (lots of Grade 10 revision)
Grade 11 Trimester 2	4(c)–(e), 5(a)–(c)	Geometry (continued) Locus Algebra	20%
Grade 11 Trimester 3	5(d)–(g), 6(a)–(d)	Algebra (continued) Graphs	20%
Grade 12 Trimester 1	7, 8, 9	Vectors Transformations Coordinate geometry Trigonometry	20%
Grade 12 Trimester 2	10	Probability Statistics	10%

In the table above, the order of the topics is the same as in the syllabus, and most of the topics contain a lot of revision of Grade 10 work. Also, keep in mind that the table on page 9 gives a summary of work that is new for candidates of the core syllabus, and that the table above is a summary of the whole syllabus (divided into five parts). You could use it as a guide when drawing up a scheme of work.

Important points to remember when teaching learners who follow the core syllabus

Link new work to existing knowledge

There is always reason to revise work with learners who are following the core syllabus. For a variety of reasons, they have probably not coped very well with the subject in their past, which is why they are taking Mathematics at the core level.

It may even be that learners deny that they have knowledge of a topic that they should have studied before. A different approach by a different teacher may cause them to think so, and in their anxiety, they may not realise that they are familiar with the topic. It is, of course, an essential didactic principle, that a teacher always establishes what learners already know before starting work on a topic. You need to find out what the learners know and understand so that the new information can be linked to existing knowledge. This also forms an important part of the learner-centred approach to teaching.

How do learners who follow the core syllabus typically fare in examinations?

When one analyses the official list of comments made by examiners of the Namibian Grade 12 Mathematics core level examination papers, it is clear that:

- learners who follow the core syllabus typically get their best marks for questions that are concrete in nature
- questions that require abstract thinking are mostly not answered as successfully as the more concrete ones
- many learners who follow the core syllabus struggle with geometry: angle measurement, construction, locus, symmetry, transformations, and trigonometry
- questions that require more advanced language skills, are often answered poorly.

A hands-on approach

It is, therefore, wise to allocate a lot of time and a *practical approach* to teaching the core topics. If all learners had a lot of practice at measuring angles, constructing, and so on (and they, preferably, have their own geometry sets, pencils, rulers, erasers and pens), they would achieve greater success than if they did not get that practice or did not have their own stationery.

Attention to language

Attention to language is very important. The teacher ought to expand the learners’ subject vocabulary and language ability. *The development of language proficiency with respect to Mathematics, is an integral part of teaching Mathematics.* As any teacher will tell you, once you have had to explain a concept to others, you understand it much better yourself. The learners should be given the opportunity to discuss the work with each other and with their teacher. In doing so, they will improve their Mathematics and their English!

A work plan for the extended level of the syllabus

Both teaching and learning this section of the syllabus require a rigorous regime of hard work. There is a great deal of challenging Mathematics at the extended level. Candidates who tackle the extended syllabus need to study the whole syllabus: everything in the core syllabus as well as everything in the extended component (the sections printed in *italics*).

As has been pointed out before, candidates who plan to study further after completing their schooling should be motivated, diligent, keen and they should love mathematics – they will follow the extended syllabus. For teachers to manage teaching all the new extended level topics for

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Mathematics, it is necessary that learners who follow the extended syllabus *accept responsibility for dealing with the core component of the syllabus by themselves*.

To start with, the teacher needs to give each learner a copy of the syllabus. Learners can then start taking responsibility by reading the syllabus so that they know what they have to revise, and then doing that revision.

For example, let us look at the first two topics, which cover the first two pages in the syllabus content section:

- 1 numbers and operations (a)–(l)
- 2 measures (a).

When studying these topics carefully, you will realise that only the following sections of the first two topics are new to the learners. (Remember, you are only looking at the first two topics now.)

Topic number	Specific objective numbers	Topic
1(a)	1	Irrational numbers
1(d)	6	Reverse percentages
1(f)	1	Standard form
1(i)	1, 2	Limits of accuracy
1(j)	6	Direct and inverse proportion

All the other specific objectives deal with topics that the learners have studied before. The learners who follow the extended syllabus should now take responsibility for revising all the work not listed in the above table. This would mean that, for example, the learners would revise all the work on ratio and proportion (1(j)), except for specific objective 6, which you should teach because it was not taught in Grade 10. It deals with topics that learners have not studied before.

Learners who are not able to recall Grade 10 work with ease, or who do not understand all the Grade 10 work, have a backlog; they might not manage to keep up with the pace and level of difficulty of the extended syllabus.

If teachers work in this manner – analysing each topic to find out which sections require revision and which topics are new – they can briefly review work previously taught and then devote most of their attention and time to teaching the new topics. Working in this way will mean that there will be sufficient time to deal with the demanding amount of work at the extended level.

Consider the broad guidelines below when drawing up a scheme of work for the extended level.

Extended level: guidelines for drawing up a scheme of work			
Teaching time	Syllabus references	Topics	Approximate percentage of syllabus content
Grade 11 Trimester 1	1, 2, 3, and 4(a) and 4(b)	Numbers and operations Measures Mensuration Geometry	30% (lots of Grade 10 revision)
Grade 11 Trimester 2	4(c)–(e), 5(a)–(c)	Geometry (continued) Locus Algebra	20%
Grade 11 Trimester 3	5(d)–(g), 6(a)–(d)	Algebra (continued) Graphs	20%
Grade 12 Trimester 1	7, 8, 9	Vectors Transformations Coordinate geometry Trigonometry	20%
Grade 12 Trimester 2	10	Probability Statistics	10%

In the above table, the order of the topics is the same as in the syllabus. The table is just a guide; teachers may find that they can cover more work in one trimester and less in another trimester with their class. This experience could then be used to adapt the scheme of work.

Teaching both levels, core and extended, in one class

Module 1, Module 2 and the *Answer Book* make teaching both levels in the same class more manageable.

It appears that in many schools learners who follow the core syllabus and those who follow the extended syllabus will be placed in the same Mathematics class. This means that teachers will need to manage the teaching of these two levels of Mathematics (which are so different in content and complexity that they require separate teaching) in their classes.

Teachers who taught the IGCSE Mathematics may tell you that they taught the extended level to all their learners, and then just examined those following the core syllabus on the appropriate content. As we now know, the extended level of the localised ordinary level syllabus, has been loaded with pure mathematics so that learners who follow this programme will be able to continue with tertiary study. Because of this, it would be neither feasible nor necessary to teach the extended content to learners who follow the core syllabus. It would be a demotivating experience for them; and little or nothing would be gained.