Leaving Cert Maths Syllabus

SIMPLIFIED

for Higher and Ordinary Levels

BREAKTHROUGH MATHS

Contents

Introduction

The Leaving Certificate Mathematics Syllabus is designed to be a roadmap for teachers, outlining the topics to be covered before the exam, the learning objectives, and the expectations for students.

But since it was written for adults who studied mathematics at third-level, it's not an easy read for a sixth-year student or parent. So, we decided to change it.

This is your complete guide to the Leaving Cert Maths course - a categorised, colour-coded, and above all, simplified version of the official syllabus, complete with a checklist so that you can use it alongside your study plan to maximise your results!

Without further ado, here is **the Leaving Cert Maths Syllabus Simplified** for Ordinary and Higher Levels!

Statistics and Probability

Statistics and Probability makes up roughly half of Maths Paper 2, so it's very important to know your stuff.

It's a lot heavier than Junior Cycle Statistics and Probability, but everything you learned from first to third year is still relevant. Here are a few Learning Outcomes that you should have a look over:

- ✅ list all possible outcomes of an experiment
- ✅ apply the fundamental principle of counting
- ✅ recognise that, if an experiment is repeated, there will be different outcomes and that increasing the number of times an experiment is repeated generally leads to better estimates of probability
- ✅ associate the probability of an event with its long-run, relative frequency

With that out of the way, we can take a look at the side-by-side comparison of the official syllabus, and the simplified version. Note that **anything in bold is for Higher Level students only!**

Topic	Students should be able to	Simplification	✅
Counting	count the arrangements of *n* distinct objects ($n!$)	calculate ($n!$)	
	count the number of ways of arranging *r* objects from *n* distinct objects	calculate permutations	
	count the number of ways of selecting *r* objects from *n* distinct objects	**calculate combinations**	
	compute binomial coefficients	**use the calculator and Log tables to calculate binomial coefficients for permutations and combinations**	

	use set theory to discuss experiments, outcomes, sample spaces	use set notation (mostly on page 23 of Log tables) to describe experiments	
	discuss basic rules of probability (AND/OR, mutually exclusive) through the use of Venn diagrams	use Venn diagrams and set notation (mostly on page 23 of Log tables) to represent probabilities	
	extend their understanding of the basic rules of probability (AND/OR, mutually exclusive) through the use of formulae **I. Addition Rule: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$** **II. Multiplication Rule (Independent Events):** **$P(A \cap B) = P(A) \times P(B)$** **III. Multiplication Rule (General Case): $P(A \cap B) = P(A) \times P(B \mid A)$**	**recognise that** **I. when two events, A and B, are non-mutually exclusive, the probability of either event A or event B occurring is written as $P(A \cup B) = P(A) + P(B) - P(A \cap B)$** **II. when events A and B are independent events, the probability of both events happening together is written as $P(A \cap B) = P(A) \times P(B)$** **III. given that event A has already occurred, the probability of both events A and B happening together (i.e. conditional probability) is written as $P(A \cap B) = P(A) \times P(B \mid A)$**	
Concepts of probability	calculate expected value and understand that this does not need to be one of the outcomes	calculate and understand expected value	
	recognise the role of expected value in decision making and explore the issue of fair games	understand the applications of expected value	
	solve problems involving sampling, with or without replacement	**answer questions that involve sampling**	
	appreciate that in general $P(A \mid B) \neq P(B \mid A)$	**understand that $P(A \mid B)$, the conditional probability of event A given that event B has occurred, is usually not the same as $P(B \mid A)$, the conditional probability of event B given that event A has occurred**	
	examine the implications of $P(A \mid B) \neq P(B \mid A)$ in context	**understand what it means that $P(A \mid B)$ and $P(B \mid A)$ are not the same**	

Outcomes of simple random processes	find the probability that two independent events both occur	use the multiplication rule	
	apply an understanding of Bernoulli trials	show an understanding of a Bernoulli trial	
	solve problems involving up to 3 Bernoulli trials	use the binomial distribution formula (page 33 of Log tables) to solve problems where $n \leq 3$	
	solve problems involving calculating the probability of *k* successes in *n* repeated Bernoulli trials (normal approximation not required)	**use the binomial distribution formula to find the probability of *k* successes in *n* trials**	
	calculate the probability that the 1st success occurs on the nth Bernoulli trial where *n* is specified	use the binomial distribution formula to find the probability that the 1st success occurs on a specified trial *n*	
	calculate the probability that the *k*th success occurs on the *n*th Bernoulli trial	**use the binomial distribution formula to find the probability that the k^{th} success occurs on the n^{th} trial**	
	use simulations to explore the variability of sample statistics from a known population, to construct sampling distributions and to draw conclusions about the sampling distribution of the mean	**use trials to understand the difference between the sample and the population, draw sampling distributions, and make conclusions based on these sampling distributions**	
	solve problems involving reading probabilities from the normal distribution tables	**use the z-tables on page 36 & 37 of Log tables and the to find the probability that a value is above, below or within certain values**	
Statistical reasoning with an aim to becoming a statistically aware consumer	discuss populations and samples	discuss populations and samples and know the difference between them	
	decide to what extent conclusions can be generalised	discuss the limitations of making conclusions from generalisations	
	work with different types of bivariate data	work with data where two types of variables are collected	
Finding, collecting and organising data	select a sample (Simple Random Sample)	select a randomised sample	

Finding, collecting and organising data (continued)	**recognise the importance of randomisation and the role of the control group in studies**	**understand why randomisation and controls are important**	
	recognise the importance of representativeness so as to avoid biased samples	understand why representativeness is important	
	recognise biases, limitations and ethical issues of each type of study	**recognise biases, limitations, and ethical issues in the studies discussed in questions**	
	discuss different types of studies: sample surveys, observational studies and designed experiments	discuss different types of studies	
	select a sample (stratified, cluster, quota – no formulae required, just definitions of these)	**define statistical terms to describe samples**	
	design a plan and collect data on the basis of above knowledge	use knowledge of statistics to plan and collect data	
Representing data graphically and numerically	describe the sample (both univariate and bivariate data) by selecting appropriate graphical or numerical methods	describe the sample using graphs or statistical measures such as mean, median, mode, range, and standard deviation	
	explore the distribution of data, including concepts of symmetry and skewness	comment on the distribution of data	
	analyse plots of the data to explain differences in measures of centre and spread	**analyse graphs to comment on the mean, median, mode, range, and standard deviation**	
	compare data sets using appropriate displays including back-to-back stem and leaf plots	compare data using different methods	
	determine the relationship between variables using scatterplots	read scatterplots	
	draw the line of best fit by eye	**draw the line of best fit**	

Representing data graphically and numerically (continued)	**make predictions based on the line of best fit**	**use the line of best fit to make predictions**	
	recognise that correlation is a value from -1 to +1 and that it measures the extent of the linear relationship between two variables	understand that correlation is the strength of a relationship between two variables on a scale from -1 to 1	
	match correlation coefficient values to appropriate scatterplots	make estimations of the correlation coefficient of a scatter plot to match it with a given value	
	calculate the correlation coefficient by calculator	**use the calculator to obtain the correlation coefficient**	
	understand that correlation does not imply causality	understand that correlation does not always mean causation	
	recognise standard deviation and interquartile range as measures of variability	understand the meaning of both standard deviation and interquartile range and that they measure variability	
	use a calculator to calculate standard deviation	use the calculator to calculate standard deviation (on page 33 of Log tables)	
	find quartiles and the interquartile range	calculate the lower, middle (median), and upper quartiles, and the interquartile range	
	use the interquartile range appropriately when analysing data	use interquartile range in appropriate contexts	
	recognise the existence of outliers	recognise outliers	
	recognise the effect of outliers	**understand the impact of outliers on data**	
	use percentiles to assign relative standing	**calculate and use percentiles to describe the relationship between a specific value in a data set with the rest of the values in the set**	
Analysing, interpreting and drawing conclusions from data	recognise how sampling variability influences the use of sample information to make statements about the population	understand how variability impacts the usefulness of sample information	

Analysing, interpreting and drawing conclusions from data (continued)	use appropriate tools to describe variability drawing inferences about the population from the sample	use different methods of describing variability (e.g. standard deviation, range) to help draw conclusions about a population from a sample	
	interpret the analysis and relate the interpretation to the original question	interpret these conclusions and use them to answer the question	
	interpret a histogram in terms of distribution of data	discuss the distribution of data on a histogram	
	make decisions based on the empirical rule	understand and use the empirical rule	
	recognise the concept of a hypothesis test	know what a hypothesis test is	
	calculate the margin of error ($\frac{1}{\sqrt{n}}$) for a population proportion	calculate the margin of error for a percentage of the population	
	conduct a hypothesis test on a population proportion using the margin of error	do a hypothesis test on a percentage of the population using the margin of error	
	build on the concept of margin of error and understand that increased confidence level implies wider intervals	**understand that increased confidence levels means that there is a wider range of values within which we believe the true value lies**	
	construct 95% confidence intervals for the population mean from a large sample and for the population proportion, in both cases using z tables	**use the z-tables on page 36 and 37 of the Log tables to construct 95% confidence intervals for the mean of the population and a percentage of the population based on a sample**	
	use sampling distributions as the basis for informal inference	**use sampling distributions to draw conclusions**	
	perform univariate large sample tests of the population mean (two-tailed z-test only)	**do a hypothesis test the population mean (using formulae on pages 34 and 35 of Log tables)**	
	use and interpret p-values	**investigate a hypothesis by calculating the probability of getting a value 'more extreme' than the test statistic using the z-tables on pages 36 and 37 of the Log tables**	

Additionally, there is a theorem that can be extremely helpful in answering Statistics questions on Paper 2 that is printed in many maths textbooks, but not explicitly written into the syllabus. It is called the **Central Limit Theorem**, and can be defined as follows:

Central Limit Theorem (Higher Level only)

- If the sample size is >30, that means the sampling distribution of the mean forms a normal distribution.
- If the underlying population is normal, the sampling distribution of the mean will always have a normal distribution even if the sample size is small (30).
- The mean of the distribution will be the same as the population mean.

Figure 1: The Central Limit Theorem

What you need to learn off

- ✅ Basic probability formulae for mutually exclusive events, **non-mutually exclusive events, independent events, and conditional probability**
- ✅ **Definitions of statistical terms stratified, cluster, and quota**
- ✅ Terms to describe the distribution of data: symmetrical, positive skew, negative skew, uniform, bimodal, multimodal
- ✅ **Empirical Rule**
- ✅ **Central Limit Theorem**
- ✅ How to perform Bernoulli Trials, hypothesis test
- ✅ **How to construct 95% confidence intervals**
- ✅ **How to calculate expected value, p-values, percentiles**

✅ **How to use the calculator to find binomial coefficients (for permutations and combinations), correlation coefficients,** and standard deviation (including from frequency tables)

Geometry and Trigonometry Strand

Geometry and Trigonometry can be a really fun and engaging aspect of the Leaving Cert Maths course, but it's also pretty content heavy.

As before, you need to know the basics from Junior Cycle, as they will form the basis for understanding new concepts. For example, you should still be able to:

✅ draw a circle of given radius

✅ use trigonometric ratios (SOH CAH TOA) to solve real world problems involving angles

✅ locate axes of symmetry in simple shapes

✅ recognise images of points and objects under translation, central symmetry, axial symmetry and rotation

Additionally, it is expected that you will be able to reproduce the **constructions** that you learned at Junior Cycle level, as well as recall the **axioms, theorems, and corollaries** to help you solve geometrical problems

In terms of theorems and corollaries, you will **NOT** be asked to reproduce their proofs, with the exception of theorems 11, 12, and 13 **at Higher Level only.**

Axioms

✅ 1. (Two Points Axiom) There is exactly one line through any two given points.

✅ 2. (Ruler Axiom) The properties of the distance between points.

- ✅ 3. (Protractor Axiom) The properties of the degree measure of an angle.
- ✅ 4. (SSS, SAS, ASA) Congruent triangles conditions,
- ✅ 5. (Axiom of Parallels) Given any line l and a point P, there is exactly one line through P that is parallel to l.

Theorems

- ✅ 1. Vertically opposite angles are equal in measure.
- ✅ 2. In an isosceles triangle the angles opposite the equal sides are equal. Conversely, if two angles are equal, then the triangle is isosceles.
- ✅ 3. If a transversal makes equal alternate angles on two lines then the lines are parallel. Conversely, if two lines are parallel, then any transversal will make equal alternate angles with them.
- ✅ 4. The angles in any triangle add to 180.
- ✅ 5. Two lines are parallel if, and only if, for any transversal, the corresponding angles are equal.
- ✅ 6. Each exterior angle of a triangle is equal to the sum of the interior opposite angles.
- ✅ 9. In a parallelogram, opposite sides and opposite angles are equal.

  Converse (i) If the opposite angles of a convex quadrilateral are equal, then it is a parallelogram.

  Converse (ii) If the opposite sides of a convex quadrilateral are equal, then it is a parallelogram.
- ✅ 10. The diagonals of a parallelogram bisect each other. Conversely, if the diagonals of a quadrilateral bisect one another, then the quadrilateral is a parallelogram.
- ✅ 14. (Pythagoras) In a right-angled triangle the square of the hypotenuse is the sum of the squares of the other two sides.

✅ 15. (Converse to Pythagoras) If the square of one side of a triangle is the sum of the squares of the other two, then the angle opposite the first side is a right angle.

✅ **19. The angle at the centre of a circle standing on a given arc is twice the angle at any point of the circle standing on the same arc.**

Corollaries

✅ **1. A diagonal divides a parallelogram into two congruent triangles.**

✅ **2. All angles at points of a circle, standing on the same arc are equal (and converse).**

✅ 3. Each angle in a semicircle is a right angle.

✅ 4. If the angle standing on a chord [BC] at some point of the circle is a right angle, then [BC] is a diameter.

✅ **5. If ABCD is a cyclic quadrilateral, then opposite angles sum to 180.**

Constructions

✅ 1. Bisector of a given angle, using only compass and straightedge.

✅ 2. Perpendicular bisector of a segment, using only compass and straightedge.

✅ 3. Line perpendicular to a given line *l*, passing through a point not on l.

✅ 4. Line perpendicular to a given line *l*, passing through a given point on *l*.

✅ 5. Line parallel to given line, through given point.

✅ 6. Division of a segment into 2, 3 equal segments, without measuring it.

✅ 7. Division of a segment into any number of equal segments, without measuring it.

✅ 8. Line segment of given length on a given ray.

✅ 9. Angle of a given number of degrees with a given ray as one arm.

✅ 10. Triangle, given lengths of three sides.

✅ 11. Triangle, given SAS data.

✅ 12. Triangle, given ASA data.

✅ 13. Right-angled triangle, given the length of the hypotenuse and one other side.

✅ 14. Right-angled triangle, given one side and one of the acute angles.

✅ 15. Rectangle, given side lengths.

Topic	Students should be able to	Simplification	✅
Synthetic geometry	perform constructions 16-21	do constructions 16-21	
	perform construction 22	**do construction 22**	
	use the following terms related to logic and deductive reasoning: theorem, proof, axiom, corollary, converse, implies, **is equivalent to, if and only if, proof by contradiction**	use geometric terms **(more needed at Higher Level)**	
	investigate theorems 7, 8, 11, 12, 13, 16, 17, 18, 20, 21 and corollary 6 and use them to solve problems	use theorems 7, 8, 11-13, 16-18, 20, and 21 and corollary 6 to solve problems	
	prove theorems 11, 12, 13, concerning ratios, which lay the proper foundation for the proof of the theorem of Pythagoras studied at junior cycle	**prove theorems 11-13**	
Co-ordinate geometry	use slopes to show that two lines are • parallel • perpendicular	prove lines are either parallel or perpendicular using the slope	
	recognise the fact that the relationship $ax + by + c = 0$ is linear	recognise $ax + by + c = 0$ is a linear equation	

	solve problems involving slopes of lines	solve problems involving slopes	
	solve problems involving • **the perpendicular distance from a point to a line** • **the angle between two lines**	**solve problems involving perpendicular distance from a point to a line and the angle between two lines (formulae on page 19 of Log tables)**	
	divide a line segment internally in a given ratio *m: n*	**divide a line segment in a given ratio (formula on page 18 of Log tables)**	
Co-ordinate geometry (continued)	calculate the area of a triangle	calculate the area of a triangle (formula on page 18 of Log tables)	
	recognise that $(x - h)^2 + (y - k)^2 = r^2$ represents the relationship between the x and y coordinates of points on circle with centre (h, k) and radius r	understand that $(x - h)^2 + (y - k)^2 = r^2$ is the formula representing a circle on the co-ordinate plane with centre (h,k) and radius r	
	recognise that $x^2 + y^2 + 2gx + 2fy + c = 0$ represents the relationship between the x and y coordinates of points on circle with centre $(-g, -f)$ and radius r where $r = \sqrt{(g^2 + f^2 - c)}$	**understand that $x^2 + y^2 + 2gx + 2fy + c = 0$ is the formula representing a circle on the co-ordinate plane with centre $(-g, -f)$ and radius r, where $r = \sqrt{(g^2 + f^2 - c)}$**	
	solve problems involving a line and a circle with centre (0, 0)	solve problems involving a line and circle with centre (0, 0)	
	solve problems involving a line and a circle	**solve problems involving a line and circle with centre other than (0,0)**	
Trigonometry	use of the theorem of Pythagoras to solve problems (2D only)	use Pythagoras' theorem	
	use trigonometry to solve problems in 3D	**use trigonometric ratios (SOH CAH TOA, on page 16 of Log tables) to solve problems using 3D objects**	
	use trigonometry to calculate the area of a triangle	calculate the area of a triangle using the formula on page 16 of Log tables	

	solve problems using the sine and cosine rules (2D)	solve problems using the sine and cosine rules (page 16 of Log tables)	
	define sin θ and cos θ for all values of θ	understand the trigonometric ratios of sin and cos (on page 16 of Log tables) and present them as a decimal, or simple fraction or surd	
	define tan θ	understand the trigonometric ratio of tan (on page 16 of Log tables) and present it as a decimal, or simple fraction or surd	
Trigonometry (continued)	**graph the trigonometric functions sine, cosine, tangent**	**draw sine, cosine, and tangent graphs**	
	graph trigonometric functions of type • $f(\theta) = a + b\text{Sin } c\theta$ • $g(\theta) = a + b\text{Cos } c\theta$ **for** $a, b, c \in \mathbb{R}$	**draw sine and cosine graphs with altered range, *a*, amplitude, *b*, and frequency, *c***	
	solve trigonometric equations such as Sin $n\theta = 0$ and Cos $n\theta = \frac{1}{2}$ giving all solutions	**use inverse trigonometric functions on the calculator and the unit circle (on page 13 of Log tables) to find all reference angles**	
	solve problems involving the area of a sector of a circle and the length of an arc	solve problems involving the area of a sector of a circle and the length of an arc (consult page 9 of Log tables)	
	use the radian measure of angles	**convert your calculator to radians and use radians to measure angles**	
	work with trigonometric ratios in surd form	work with trigonometric ratios in surd form (consult page 13 of Log tables)	
	derive the trigonometric formulae 1, 2, 3, 4, 5, 6, 7, 9	**prove trigonometric formulae 1-7 & 9 (on pages 13-14 of Log tables)**	
	apply the trigonometric formulae 1-24	**use trigonometric formulae 1-24 to solve problems (on pages 13-15)**	

Transformation geometry, enlargements	investigate enlargements and their effect on area, paying attention to • centre of enlargement • scale factor k where $0 < k < 1 \in \mathbb{Q}$	understand how the centre of enlargement and scale factor affects the area of an enlargement	
	solve problems involving enlargements	solve problems involving enlargements	

What you need to learn off

✅ How to use the instruments: straight edge, compass, ruler, protractor and set square appropriately when drawing geometric diagrams

✅ Definition of geometric terms theorem, proof, axiom, corollary, implies, converse, **is equivalent to, if and only if, proof by contradiction**

✅ Constructions 1-21 **(+ 22 at Higher Level)**

16. Circumcentre and circumcircle of a given triangle, using only straightedge and compass.

17. Incentre and incircle of a given triangle, using only straight-edge and compass.

18. Angle of 60°, without using a protractor or set square.

19. Tangent to a given circle at a given point on it.

20. Parallelogram, given the length of the sides and the measure of the angles.

21. Centroid of a triangle.

22. Orthocentre of a triangle.

✅ Corollaries 1-6*

6. If two circles share a common tangent line at one point, then the two centres and that point are collinear) to help answer questions

✅ Theorems 1-21* **and formal proofs of Theorems 11-13**

7. (i) The angle opposite the greater of two sides is greater than the angle opposite the lesser side.

(ii) Conversely, the side opposite the greater of two angles is greater than the side opposite the lesser angle.

8. Two sides of a triangle are together greater than the third.

11. If three parallel lines cut off equal segments on some transversal line, then they will cut off equal segments on any other transversal.

12. Let ABC be a triangle. If a line l is parallel to BC and cuts [AB] in the ratio *m:n*, then it also cuts [AC] in the same ratio. Conversely, if the sides of two triangles are in proportion, the two triangles are similar.

13. If two triangles are similar, then their sides are proportional, in order $\frac{|AB|}{|A'B'|} = \frac{|BC|}{|B'C'|} = \frac{|AC|}{|A'C'|}$ (and converse).

16. For a triangle, base x height does not depend on choice of base.

17. A diagonal of a parallelogram bisects the area.

18. The area of a parallelogram is the base x height.

20. (i) Each tangent is perpendicular to the radius that goes to the point of contact.

(ii) If P lies on the circle S, and a line l is perpendicular to the radius to P, then l is a tangent to S.

21. (i) The perpendicular from the centre to a chord bisects the chord.

(ii) The perpendicular bisector of a chord passes through centre.

✅ **Properties of the quadrants of the Unit Circle (CAST) and how to calculate reference angles**

✅ **How to derive trigonometric formulae 1-7 and 9**

1. $\cos^2 A + \sin^2 A = 1$
2. sine formula: $\frac{a}{Sin\ A} = \frac{b}{Sin\ B} = \frac{c}{Sin\ C}$

3. cosine formula: $a^2 = b^2 + c^2 - 2bc \cos A$

4. $\cos(A - B) = \cos A \cos B + \sin A \sin B$

5. $\cos(A + B) = \cos A \cos B - \sin A \sin B$

6. $\cos 2A = \cos^2 A - \sin^2 A$

7. $\sin(A + B) = \sin A \cos B + \cos A \sin B$

9. $\dfrac{\tan A + \tan B}{1 - \tan A \tan B}$

Number Strand

This section of the syllabus, like the others, builds on Junior Cycle concepts and a lot of it is the sort of thing that, **once you learn it, you won't forget it**.

That said, there are a few trickier concepts, like logs, introduced to Higher Level students, so don't completely overlook this strand!

Topic	Students should be able to	Simplification	✅
Number systems	recognise irrational numbers and appreciate that $\mathbb{R} \neq \mathbb{Q}$	recognise irrational numbers as those that can't be written as a fraction and that not all real numbers are rational	
	work with irrational numbers	work with irrational numbers	
	revisit the operations of addition, multiplication, subtraction and division in the following domains: • $\mathbb{N}$ of natural numbers • $\mathbb{Z}$ of integers • $\mathbb{Q}$ of rational numbers • $\mathbb{R}$ of real numbers and represent these numbers on a number line	perform all basic arithmetic operations on natural numbers, integers, rational numbers, and real numbers and represent them on the number line	
	geometrically construct $\sqrt{2}$ and $\sqrt{3}$	**construct $\sqrt{2}$ and $\sqrt{3}$**	

	prove that $\sqrt{2}$ is not rational	**prove that $\sqrt{2}$ is not rational**	
	investigate the operations of addition, multiplication, subtraction and division with complex numbers $\mathbb{C}$ in rectangular form $a + ib$	perform all basic arithmetic operations on complex numbers in the form $a + bi$	
	calculate conjugates of sums and products of complex numbers	**calculate conjugates of sums and products of complex numbers**	
Number systems (continued)	illustrate complex numbers on an Argand diagram	show complex numbers on an Argand diagram	
	interpret the modulus as distance from the origin on an Argand diagram and calculate the complex conjugate	understand the concept of the modulus on an Argand diagram	
	develop decimals as special equivalent fractions, strengthening the connection between these numbers and fraction and place-value understanding	express decimals as special equivalent fractions and understand place-value	
	consolidate their understanding of factors, multiples, prime numbers in $\mathbb{N}$	apply an understanding of factors, multiples, and prime numbers	
	express numbers in terms of their prime factors	express numbers in terms of their prime factors	
	appreciate the order of operations, including brackets	follow BIMDAS	
	express non-zero positive rational numbers in the form $a \times 10^n$, where $n \in \mathbb{Z}$ and $1 \leq a < 10$ and perform arithmetic operations on numbers in this form	present large numbers using scientific notation and work with numbers presented this way	
Sequences and Series	appreciate that processes can generate sequences of numbers or objects	understand that operations can create a sequence	
	investigate patterns among these sequences	find patterns in sequences	

	use patterns to continue the sequence	use patterns to continue the sequence	
	generalise and explain patterns and relationships in algebraic form	use variables in the representation of a pattern	
	recognise whether a sequence is arithmetic, geometric or neither	recognise whether a sequence is arithmetic, geometric or neither	
	find the sum to n terms of an arithmetic series	use the formula on page 22 of the Log tables to find the sum of n terms	
Sequences and Series (continued)	**verify and justify formulae from number patterns**	**test the formula against the pattern by substituting values**	
	investigate geometric sequences and series	**work with geometric sequences and series (page 22 of Log tables)**	
	prove by induction • **simple identities such as the sum of the first n natural numbers and the sum of a finite geometric series** • **simple inequalities such as** – $n! > 2^n$ – $2^n \geq n^2$ $(n \geq 4)$ – $(1 + x)^n \geq 1 + nx$ $(x > -1)$ • **factorisation results such as 3 is a factor of $4n$ –1**	**prove by induction** • **sum of a geometric series** • **inequalities** • **divisibility/factors**	
	apply the rules for sums, products, quotients of limits	**apply the rules of induction for sums, products, and quotients**	
	find by inspection the limits of sequences such as • $\lim\limits_{n \to \infty} \frac{n}{n+1}$ • $\lim\limits_{n \to \infty} r^n$ **where** $\lvert r \rvert < 1$	**find the limits of sequences**	
	solve problems involving finite and infinite geometric series including	**use the geometric series formula on page 22 of the Log tables to**	

	applications such as recurring decimals and financial applications, e.g. deriving the formula for a mortgage repayment	**solve problems including (but not limited to) deriving the amortisation formula, page 31 of Log tables)**	
	derive the formula for the sum to infinity of geometric series by considering the limit of a sequence of partial sums	**derive the formula for the sum of an infinite geometric series (on page 22 of the Log tables)**	
Indices	solve problems using the rules for indices (where $a, b \in \mathbb{R}$; $p, q \in \mathbb{Q}$; a^p, $a^q \in \mathbb{Q}$; $a, b \neq 0$): • $a^p a^q = a^{p+q}$ • $\frac{a^p}{a^q} = a^{p-q}$ • $a^0 = 1$ • $(a^p)^q = a^{pq}$ • $a^{\frac{1}{q}} = \sqrt[q]{a}$ $q \in \mathbb{Z}, q \neq 0, a > 0$ • $a^{\frac{p}{q}} = \sqrt[q]{a^p} = (\sqrt[q]{a})^p = p, q \in \mathbb{Z}, q \neq 0, a > 0$ • $a^{-p} = \frac{1}{a^p}$ • $(ab)^p = a^p b^p$ • $(\frac{a}{b})^p = \frac{a^p}{b^p}$	use the Laws of Indices on page 21 of the Log tables to solve problems	
	solve problems using the rules of logarithms • $\log_a(xy) = \log_a x + \log_a y$ • $\log_a(\frac{x}{y}) = \log_a x - \log_a y$ • $\log_a x^q = q\log_a x$	**use the Laws of Logarithms on page 21 of the Log tables to solve problems**	

	• $\log_a a = 1$ • $\log_a 1 = 0$ • $\log_a x = \dfrac{\log_b x}{\log_b a}$		
Arithmetic	check a result by considering whether it is of the right order of magnitude and by working the problem backwards; round off a result	verify that you have presented your results correctly	
	accumulate error (by addition or subtraction only)	accumulate error	
	make and justify estimates and approximations of calculations; calculate percentage error and tolerance	make and justify estimations and calculate percentage error and tolerance	
	calculate average rates of change (with respect to time)	calculate average rates of change over time	
	solve problems that involve • calculating cost price, selling price, loss, discount, mark up (profit as a % of cost price), margin (profit as a % of selling price) • compound interest, depreciation (reducing balance method), income tax and net pay (including other deductions) • costing: materials, labour and wastage • metric system; change of units; everyday imperial units (conversion factors provided for imperial units)	solve problems involving • basic financial maths • compound interest, depreciation (formulae on page 30 of log tables), income tax, and net pay • costing • conversion	

	use 'present' value when solving problems involving loan repayments and investments	**use present value (formula on page 30 of Log tables) when solving problems involving loan repayments and investments**	
	make estimates of measures in the physical world around them	make estimates of measures	
Length, area and volume	investigate the nets of prisms, cylinders and cones	examine the nets of various 3D shapes	
	solve problems involving the length of the perimeter and the area of plane figures: disc, triangle, rectangle, square, parallelogram, trapezium, sectors of discs, and figures made from combinations of these	solve problems involving the perimeter and area of various 2D shapes (mostly on pages 8 and 9 of the Log tables) and shape combinations	
	solve problems involving surface area and volume of the following solid figures: rectangular block, cylinder, right cone, triangular-based prism (right angle, isosceles and equilateral), sphere, hemisphere, and solids made from combinations of these	solve problems involving the surface area and/or volume of various 3D shapes (mostly on pages 10 and 11 of the Log tables) and shape combinations	
	use the trapezoidal rule to approximate area	use the trapezoidal rule on page 12 of the Log tables	

What you need to learn off

- ✅ **Constructions of √2 and √3**
- ✅ **Proof that √2 is not rational**
- ✅ **Proof by Induction**
  - **(i) Divisibility/Factors**
  - **(ii) Series**
  - **(iii) Inequality**
- ✅ **Proof of the Sum of Geometric Series**

- ✅ **Proof of the Sum of Infinite Geometric Series Formula**
- ✅ **How to derive the Amortisation Formula**

Algebra Strand

Algebra makes up **roughly 60% of Paper 1**, but a grasp of the basic concepts is necessary to answer **almost every single question on both papers**.

It's also one of the first topics that you will cover in Fifth Year, so it may be a good idea to have a look over the following Junior Cycle Learning Outcomes:

- ✅ generate a generalised expression for linear and quadratic patterns in words and algebraic expressions and fluently convert between each
- ✅ divide quadratic and cubic expressions by linear expressions, where all coefficients are integers and there is no remainder
- ✅ flexibly convert between the factorised and expanded forms of algebraic expressions

Topic	Students should be able to	Simplification	✅
Expressions	evaluate expressions given the value of the variables	solve an equation when you have the value of the variable	
	expand and re-group expressions	expand and simplify expressions	
	apply the binomial theorem	**use the binomial theorem on page 20 of the Log tables**	
	factorise expressions of order 2	factorise expressions involving a variable raised to the power of 2	

	add and subtract expressions of the form • $(ax + by + c) \pm \ldots \pm (dx + ey + f)$ • $(ax^2 + by + c) \pm \ldots \pm (dx^2 + ey + f)$ where $a, b, c, d, e, f \in \mathbb{Z}$ • $\dfrac{a}{bx+c} \pm \dfrac{p}{qx+r}$ where $a, b, c, d, e, f \in \mathbb{Z}$	add and subtract algebraic expressions in various forms	
Expressions (continued)	use the associative and distributive properties to simplify expressions of the form • $a(bx + cy + d) \pm \ldots \pm e(fx + gy + h)$ where $a, b, c, d, e, f, g, h \in \mathbb{Z}$ • $(x \pm y)(w \pm z)$	simplify algebraic expressions	
	perform the arithmetic operations of addition, subtraction, multiplication and division on polynomials and rational algebraic expressions paying attention to the use of brackets and surds	**apply BIMDAS to algebraic expressions**	
	rearrange formulae	rearrange formulae	

Solving Equations	select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations of the form: • $f(x) = g(x)$, with $f(x) = ax + b$, $g(x) = cx + d$ where $a, b, c, d \in \mathbb{Q}$ • $f(x) = g(x)$, with $f(x) = \frac{a}{bx + c} \pm \frac{p}{qx + r}$ $g(x) = \frac{e}{f}$ where $a, b, c, e, f, p, q, r, \in \mathbb{Z}$ • $f(x) = k$ with $f(x) = ax^2 + bx + c$ (and not necessarily factorisable) where $a, b, c \in \mathbb{Q}$ and interpret the results	use different methods to find solutions to algebraic expressions in a variety of forms, including linear, quadratic, and fractions where a linear expression forms the denominator	
Solving Equations (continued)	**select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations of the form:** $f(x) = g(x)$ **with** $f(x) = \frac{ax + b}{ex + f} \pm \frac{cx + d}{qx + r}$ $g(x) = k$ **where** $a, b, c, d, e, f, q, r, \in \mathbb{Z}$	**use different methods to find solutions to algebraic expressions involving fractions, where both the numerator and denominator are linear expressions**	

	select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to • simultaneous linear equations with two unknowns and interpret the results • one linear equation and one equation of order 2 with two unknowns (restricted to the case where either the coefficient of x or the coefficient of y is ± 1 in the linear equation) and interpret the results	use different methods to find solutions to algebraic expressions in a variety of forms, including • simultaneous linear equations • linear and quadratic equations	
	select and use suitable strategies (graphic, numeric, algebraic and mental) for finding solutions to • **cubic equations with at least one integer root** • **simultaneous linear equations with three unknowns** • **one linear equation and one equation of order 2 with two unknowns** **and interpret the results**	**use different methods to find solutions to algebraic expressions in a variety of forms, including** • **cubic equations** • **simultaneous linear equations with three unknowns** • **linear and quadratic equations with two unknown values**	
Solving Equations (continued)	form quadratic equations given whole number roots	use given roots to form a quadratic equation	
	use the Factor Theorem for polynomials	**apply the knowledge that if f(a) = 0, then (x – a) is a factor of f(x)**	

Inequalities	select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: • $g(x) \le k$, $g(x) \ge k$ • $g(x) < k$, $g(x) > k$ where $g(x) = ax + b$ and $a, b, k \in \mathbb{Q}$	find solutions to linear inequalities	
	use notation $\mid x \mid$	**understand and use absolute value**	
	select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: • $g(x) \le k$, $g(x) \ge k$ • $g(x) < k$, $g(x) > k$ **with** $g(x) = ax^2 + bx + c$ **or** $g(x) = \dfrac{ax+b}{cx+d}$ **and** $a, b, c, d, k \in \mathbb{Q}$, $x \in \mathbb{R}$ • $\mid x - a \mid < b$, $\mid x - a \mid > b$ **and combinations of these, with** $a, b, \in \mathbb{Q}$, $x \in \mathbb{R}$	**find solutions to inequalities in quadratic, absolute, and fraction form, where both the numerator and denominator are linear expressions**	
Complex Numbers	**use the Conjugate Root Theorem to find the roots of polynomials**	**apply the knowledge that if $(a + bi)$ is a root of $f(x)$, then the conjugate, $a - bi$, is also a root**	
Complex Numbers (continued)	**work with complex numbers in rectangular and polar form to solve quadratic and other equations including those in the form $z^n = a$, where $n \in \mathbb{Z}$ and $z = r$ (Cos θ + iSin θ)**	**work with complex numbers to solve equations**	
	use De Moivre's Theorem	**use De Moivre's Theorem**	

	prove De Moivre's Theorem by induction for $n \in \mathbb{N}$	prove De Moivre's Theorem by induction	
	use applications such as *n*th roots of unity, $n \in \mathbb{N}$, and identities such as $\text{Cos } 3\theta = 4 \text{ Cos}^3\theta - 3 \text{ Cos } \theta$	use applications such as the *n*th roots of unity and trigonometric identities	

What you need to learn off

- ✅ Factor Theorem
- ✅ Conjugate Root Theorem
- ✅ How to derive DeMoivre's Theorem

Functions Strand

Junior Cycle Maths offers fairly limited exposure to functions, but at Leaving Cert level, there's quite a lot you need to know, especially with the addition of **calculus and trigonometric graphs**.

Thankfully, the syllabus offers you the chance to reacquaint yourself with functions at the most basic level, so there's no need to panic. One thing that *is* worth carrying over from Junior Cycle is **how to use the calculator to get a table of values from a given function.** It'll save you a lot of time!

Topic	Students should be able to	Simplification	✅
Functions	recognise that a function assigns a unique output to a given input	understand that every x-value has a corresponding y-value	
	form composite functions	form nested functions, i.e. $f(g(x))$	
	recognise surjective, injective and bijective functions	**recognise surjective, injective and bijective functions**	
	find the inverse of a bijective function	**find the inverse of a function**	
	given a graph of a function sketch the graph of its inverse	**sketch the inverse of a given graph**	
	graph functions of the form • $ax + b$ where $a, b \in \mathbb{Q}$, $x \in \mathbb{R}$ • $ax^2 + bx + c$ where $a, b, c \in \mathbb{Z}$, $x \in \mathbb{R}$ • $ax^3 + bx^2 + cx + d$ where $a, b, c, d \in \mathbb{Z}$, $x \in \mathbb{R}$ • ab^x where $a \in \mathbb{N}$, $b, x \in \mathbb{R}$	graph linear, quadratic, cubic, and exponential functions	

	interpret equations of the form *f(x) = g(x)* as a comparison of the above functions	work with simultaneous equations of the above form and combinations of	
	graph functions of the form • $ax^2 + bx + c$ **where** $a, b, c \in \mathbb{Q}$, $x \in \mathbb{R}$ • ab^x **where** $a, b \in \mathbb{R}$ • **logarithmic** • **exponential** • **trigonometric**	**graph quadratic functions (with rational coefficients), exponential functions (with variables being real numbers), as well as logarithmic and trigonometric functions**	
	interpret equations of the form *f(x) = g(x)* as a comparison of the above functions	**work with simultaneous equations of the above form and combinations of**	
Functions (continued)	use graphical methods to find approximate solutions to • $f(x) = 0$ • $f(x) = k$ • $f(x) = g(x)$ where *f(x)* and *g(x)* are of the above form, or where graphs of *f(x)* and *g(x)* are provided	use graphs to find approximations of where • $f(x) = 0$, or the x-intercept • $f(x) = k$, or intersects with a specified line • $f(x) = g(x)$, or the intersection of two graphs	
	express quadratic functions in complete square form	**represent functions in square form**	
	use the complete square form of a quadratic function to • **find the roots and turning points** • **sketch the function**	**use the square form to find roots and turning points and to make a sketch of the function**	
	investigate the concept of the limit of a function	understand the concept of the limit of a function	
	informally explore limits and continuity of functions	**understand how to approximate the limit of a function**	

Calculus	find first and second derivatives of linear, quadratic and cubic functions by rule	find the first and second derivatives of linear, quadratic, and cubic functions	
	differentiate the following functions • **polynomial** • **exponential** • **trigonometric** • **rational powers** • **inverse functions** • **logarithms**	**know how to differentiate different types of functions (consult page 25 of Log tables)**	
	find the derivatives of sums, differences, products, quotients and compositions of functions of the above form	**use the sum, product, quotient, and chain rules (latter three on page 25 of Log tables) to solve problems**	
	differentiate linear and quadratic functions from first principles	**differentiate linear and quadratic functions from first principles**	
	associate derivatives with slopes and tangent lines	understand that the derivative of a function at a specific point represents the slope of the tangent line to the graph of that function at that point	
	use differentiation to find the slope of a tangent to a circle	**use differentiation to find the slope of a line lying tangent to a circle**	
	apply differentiation to • rates of change • maxima and minima • curve sketching	apply differentiation to • rates of change • maxima and minima • curve sketching	
	apply the differentiation of above functions to solve problems	**use differentiation to solve problems**	
	recognise integration as the reverse process of differentiation	**understand that integration is the differentiation backwards**	

Calculus (continued)	use integration to find the average value of a function over an interval	use integration to find the average value of a function over time	
	integrate sums, differences and constant multiples of functions of the form • x^a where $a \in \mathbb{Q}$ • a^x where $a \in \mathbb{R}$, $a > 0$ • Sin ax where $a \in \mathbb{R}$ • Cos ax where $a \in \mathbb{R}$	know how to integrate different types of functions (consult page 26 of Log tables)	
	determine areas of plane regions bounded by polynomial and exponential curves	calculate the area between two curves	

What you need to learn off

✅ Completing the Square Formula

✅ Differentiation by First Principles

(i) Linear expressions

(ii) Quadratic expressions

Assessment

The Leaving Cert Maths course ends with two final exams in June of sixth year:

- ✅ Paper 1, which focuses on Strands 3, 4, and 5 **(Number, Algebra, and Functions)**
- ✅ Paper 2, which focuses on Strand 1 and 2 **(Statistics and Probability, Geometry and Trigonometry)**

For both Higher and Ordinary levels Each paper is **2.5 hours** in length, carries **equal marks**, and contains **two sections**:

- ✅ Section A, which focuses on **concepts and skills**
- ✅ Section B which include questions that are context-based applications of those concepts and skills, i.e. **problem solving**

You are allowed to bring with you the following instruments into the exam hall:

- ✅ calculator (model must be approved for use by SEC)
- ✅ straight edge
- ✅ compass
- ✅ ruler
- ✅ protractor
- ✅ set square

You will be given a copy of the Log tables by the superintendent, but it is worth buying one for yourself or downloading the PDF version so that you can familiarise yourself with the pages you will need. We have mentioned most of the important pages in the syllabus simplification.

Conclusion

The Leaving Cert Maths course is no joke, especially at Higher Level. The course is designed to be completed over **180 hours,** but it requires many hours of independent work on top of that if you want to do well.

But, with the help of this simplified syllabus and the accompanying checklist, you'll be able to **identify where your strengths and weaknesses lie**, as well as the **topics that you haven't covered in class**, so that you can raise it with your teacher, or seek help outside of school with the likes of ourselves!

If you or someone you know is looking for maths grinds, head over to our website at www.breakthroughmaths.com to book in for a FREE trial!

Best of luck in the exams!

The Breakthrough Maths Team

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