Leaving Certificate Mathematics: OL Learning Outcomes

Introduction

This document lists the Ordinary Level learning outcomes for the Leaving Certificate Mathematics course, organized by the five strands:

1. Statistics and Probability
2. Geometry and Trigonometry
3. Number
4. Algebra
5. Functions

1 Strand 1: Statistics and Probability (OL)

1.1 Counting

- Count the arrangements of n distinct objects ($n!$)
- Count the number of ways of arranging r objects from n distinct objects

1.2 Concepts of Probability

- Use set theory to discuss experiments, outcomes, sample spaces
- Discuss basic rules of probability (AND/OR, mutually exclusive) using Venn diagrams
- Calculate expected value and understand it need not be an outcome
- Recognise the role of expected value in decision making and fair games

1.3 Outcomes of Random Processes

- Find probability that two independent events both occur
- Apply understanding of Bernoulli trials
- Solve problems involving up to 3 Bernoulli trials
- Calculate probability that the 1st success occurs on the nth trial

1.4 1.4 Statistical Reasoning

- Discuss populations and samples

- Decide to what extent conclusions can be generalised
- Work with different types of bivariate data

1.5   1.5 Finding, Collecting and Organising Data

- Select a simple random sample
- Recognise importance of representativeness
- Discuss sample surveys, observational studies, designed experiments
- Design a plan and collect data

1.6   1.6 Representing Data Graphically and Numerically

1.6.1   Graphical

- Describe sample using appropriate graphical/numerical methods
- Explore distribution, symmetry, skewness
- Compare data sets using back-to-back stem and leaf plots
- Determine relationship between variables using scatterplots
- Recognise correlation $(-1$ to $+1)$ and its meaning
- Match correlation coefficients to scatterplots
- Understand correlation does not imply causality

1.6.2   Numerical

- Recognise standard deviation and IQR as measures of variability
- Use calculator for standard deviation
- Find quartiles and IQR
- Use IQR appropriately
- Recognise outliers

1.7   1.7 Analysing, Interpreting and Drawing Inferences

- Recognise sampling variability
- Use tools to describe variability and draw inferences
- Interpret analysis in context of original question
- Interpret histograms
- Make decisions using empirical rule
- Recognise hypothesis test concept
- Calculate margin of error $\frac{1}{\sqrt{n}}$ for proportion
- Conduct hypothesis test on proportion using margin of error

2 Strand 2: Geometry and Trigonometry (OL)

2.1 2.1 Synthetic Geometry

- Perform constructions 16–21
- Use terms: theorem, proof, axiom, corollary, converse, implies
- Investigate and use theorems 7, 8, 11, 12, 13, 16, 17, 18, 20, 21 and corollary 6

2.2 2.2 Coordinate Geometry

- Use slopes to show lines parallel/perpendicular
- Recognise $ax + by + c = 0$ as linear
- Solve slope problems
- Calculate area of a triangle
- Recognise $(x - h)^2 + (y - k)^2 = r^2$ as circle equation
- Solve problems involving a line and circle centred at origin

2.3 2.3 Trigonometry

- Use Pythagoras' theorem (2D)
- Use trigonometry to find area of triangle
- Solve problems using sine and cosine rules (2D)
- Define $\sin \theta$, $\cos \theta$, $\tan \theta$ for all θ
- Solve problems involving arc length and sector area
- Work with trigonometric ratios in surd form

2.4 2.4 Transformation Geometry, Enlargements

- Investigate enlargements and effect on area
- Identify centre of enlargement and scale factor $k \in \mathbb{Q}$
- Solve problems involving enlargements

3 Strand 3: Number (OL)

3.1 3.1 Number Systems

- Recognise irrational numbers, $\mathbb{R} \neq \mathbb{Q}$
- Work with irrational numbers
- Revisit operations in $\mathbb{N}, \mathbb{Z}, \mathbb{Q}, \mathbb{R}$
- Represent numbers on a number line

- Develop decimals as equivalent fractions
- Consolidate factors, multiples, primes
- Express numbers in prime factor form
- Appreciate order of operations
- Express numbers in standard form $a \times 10^n$

3.2 3.2 Sequences and Indices

3.2.1 Sequences

- Recognise sequences generated by processes
- Investigate patterns
- Generalise patterns algebraically
- Identify arithmetic/geometric sequences
- Find sum of n terms of arithmetic series

3.2.2 Indices

- Solve problems using index laws:
  - $a^p a^q = a^{p+q}$
  - $\frac{a^p}{a^q} = a^{p-q}$
  - $a^0 = 1$
  - $(a^p)^q = a^{pq}$
  - $\frac{1}{a^q} = \sqrt[q]{a}$
  - $a^{\frac{p}{q}} = \sqrt[q]{a^p}$
  - $a^{-p} = \frac{1}{a^p}$
  - $(ab)^p = a^p b^p$
  - $\left(\frac{a}{b}\right)^p = \frac{a^p}{b^p}$

3.3 3.3 Arithmetic

- Check results by estimation and reverse working
- Round results appropriately
- Understand accumulation of error
- Make and justify estimates
- Calculate average rates of change
- Solve problems involving:
  - Cost price, selling price, profit/loss, discount, markup, margin
  - Compound interest, depreciation, tax, net pay

- Costing: materials, labour, wastage
  - Metric/imperial unit conversion
- Estimate real-world measures

3.4   3.4 Length, Area and Volume

- Investigate nets of prisms, cylinders, cones
- Solve perimeter and area problems for:
  - Disc, triangle, rectangle, square, parallelogram, trapezium, sector
- Solve surface area and volume problems for:
  - Rectangular block, cylinder, cone, prism, sphere, hemisphere
- Use trapezoidal rule to approximate area

4   Strand 4: Algebra (OL)

4.1   4.1 Expressions

- Evaluate expressions given variable values
- Expand and regroup expressions
- Factorise quadratic expressions
- Add/subtract expressions of forms:
  - $(ax + by + c) \pm \ldots$
  - $(ax^2 + bx + c) \pm \ldots$
  - $\frac{a}{bx+c} \pm \frac{p}{qx+r}$
- Use associative/distributive properties
- Rearrange formulae

4.2   4.2 Solving Equations

- Solve $f(x) = g(x)$ where f, g are linear
- Solve rational equations of form $\frac{a}{bx+c} + \frac{p}{qx+r} = \frac{e}{f}$
- Solve quadratic equations $ax^2 + bx + c = k$
- Solve simultaneous linear equations (2 unknowns)
- Solve one linear + one quadratic (restricted case)
- Form quadratic equations given whole number roots

4.3   4.3 Inequalities

- Solve linear inequalities $g(x) \le k, < k, > k, \ge k$

5 Strand 5: Functions (OL)

5.1 5.1 Functions

- Recognise a function assigns unique output to input
- Form composite functions
- Graph functions:
  - $ax + b$
  - $ax^2 + bx + c$
  - $ax^3 + bx^2 + cx + d$
  - ab^x
- Interpret $f(x) = g(x)$ as comparison of functions
- Use graphical methods to solve $f(x) = 0$ or $f(x) = k$
- Investigate limit of a function

5.2 5.2 Calculus

- Find first and second derivatives of linear/quadratic/cubic functions
- Associate derivative with slope and tangent line
- Apply differentiation to rates of change
- Find maxima and minima
- Sketch curves using derivatives