Strand 2: Geometry and Trigonometry

The synthetic geometry covered at Leaving Certificate is a continuation of that studied at junior cycle. It is based on *Geometry for Post-primary School Mathematics*, including terms, definitions, axioms, propositions, theorems, converses and corollaries. The formal underpinning for the system of post-primary geometry is that described by Barry (2001)[1].

At each syllabus level, knowledge of geometrical results from the corresponding syllabus level at Junior Certificate is assumed. It is also envisaged that at all levels students will engage with a dynamic geometry software package.

In particular, at Foundation level and Ordinary level learners should first encounter the geometrical results below through investigation and discovery. Learners are asked to accept these results as true for the purpose of applying them to various contextualised and abstract problems. They should come to appreciate that certain features of shapes or diagrams appear to be independent of the particular examples chosen. These apparently constant features or results can be established in a formal manner through logical proof. Even at the investigative stage, ideas involved in mathematical proof can be developed. Learners should become familiar with the formal proofs of the specified theorems (some of which are examinable at Higher level). Learners will be assessed by means of problems that can be solved using the theory.

1 P.D. Barry. *Geometry with Trigonometry*, Horwood, Chicester (2001)

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Students learn about	Students working at FL should be able to	In addition, students working at OL should be able to	In addition, students working at HL should be able to
2.1 Synthetic geometry *	– perform constructions **18, 19, 20** (see *Geometry for Post-primary School Mathematics*)	– perform constructions **16, 17, 21** (see *Geometry for Post-primary School Mathematics*) – use the following terms related to logic and deductive reasoning: theorem, proof, axiom, corollary, converse, implies – investigate theorems **7, 8, 11, 12, 13, 16, 17, 18, 20, 21** and **corollary 6** (see *Geometry for Post-primary School Mathematics*) and use them to solve problems	– perform constructions **1-15** and **22** (see *Geometry for Post-primary School Mathematics*) – use the following terms related to logic and deductive reasoning: is equivalent to, if and only if, proof by contradiction – prove theorems **11, 12, 13,** concerning ratios (see *Geometry for Post-primary School Mathematics*), which lay the proper foundation for the proof of the theorem of Pythagoras studied at junior cycle
2.2 Co-ordinate geometry	– use slopes to show that two lines are • parallel • perpendicular – recognise the fact that the relationship $ax + by + c = 0$ is linear – solve problems involving slopes of lines	– calculate the area of a triangle – recognise that $(x-h)^2 + (y-k)^2 = r^2$ represents the relationship between the x and y co-ordinates of points on a circle centre (h, k) and radius r – solve problems involving a line and a circle with centre (0, 0)	– solve problems involving • the perpendicular distance from a point to a line • the angle between two lines – divide a line segment internally in a given ratio m:n – recognise that $x^2+y^2+2gx+2fy+c = 0$ represents the relationship between the x and y co-ordinates of points on a circle centre $(-g,-f)$ and radius r where $r = \sqrt{(g^2+f^2 - c)}$ – solve problems involving a line and a circle

* In the examination, candidates will have the option of answering a question on the synthetic geometry set out here, or answering a problem-solving question based on the geometrical results from the corresponding syllabus level at Junior Certificate. This option will apply for a three year period only, for candidates sitting the Leaving Certificate examination in 2012, 2013 and 2014. There will be no choice after that stage.

Students learn about	Students working at FL should be able to	In addition, students working at OL should be able to	In addition, students working at HL should be able to
2.3 Trigonometry	– use the theorem of Pythagoras to solve problems (2D only)	– use trigonometry to calculate the area of a triangle – solve problems using the sine and cosine rules (2D) – define sin θ and cos θ for all values of θ – define tan θ – solve problems involving area of a sector of a circle and the length of an arc – work with trigonometric ratios in surd form	– use trigonometry to solve problems in 3D – graph the trigonometric functions sine, cosine, tangent – graph trigonometric functions of type $a\text{Sin } n\theta$, $a\text{Cos } n\theta$ for $a, n \in \text{N}$ – solve trigonometric equations such as $\text{Sin } n\theta = 0$ and $\text{Cos } n\theta = \frac{1}{2}$ giving all solutions – use the radian measure of angles – derive the trigonometric formulae 1, 2, 3, 4, 5, 6, 7, 9 (see appendix) – apply the trigonometric formulae 1-24 (see appendix)
2.4 Transformation geometry, enlargements	– investigate enlargements paying attention to • centre of enlargement • scale factor k, where $0<k<1$, $k>1$ $k \in \mathbf{Q}$ • area – solve problems involving enlargements		

Students learn about	Students should be able to
2.5 Synthesis and problem-solving skills	– explore patterns and formulate conjectures – explain findings – justify conclusions – communicate mathematics verbally and in written form – apply their knowledge and skills to solve problems in familiar and unfamiliar contexts – analyse information presented verbally and translate it into mathematical form – devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.