

Diploma Programme subject outline—Group 5: mathematics			
School name	La Costa Canyon High School	School code	924174
Name of the DP subject <i>(indicate language)</i>	Mathematics HL (English)		
Level <i>(indicate with X)</i>	Higher <input checked="" type="checkbox"/>	Standard completed in two years <input type="checkbox"/>	Standard completed in one year * <input type="checkbox"/>
Name of the teacher who completed this outline	Michelle Anderson and Joe Zyburn	Date of IB training	3/12/2017-3/14/2017
Date when outline was completed	5/15/2017	Name of workshop <i>(indicate name of subject and workshop category)</i>	Mathematical SL Category 1 Mathematical HL CAT 2 (to be attended)

* All Diploma Programme courses are designed as two-year learning experiences. However, up to two standard level subjects, excluding languages ab initio and pilot subjects, can be completed in one year, according to conditions established in the *Handbook of procedures for the Diploma Programme*.

1. Course outline

- Use the following table to organize the topics to be taught in the course. If you need to include topics that cover other requirements you have to teach (for example, national syllabus), make sure that you do so in an integrated way, but also differentiate them using italics. Add as many rows as you need.
- This document should not be a day-by-day accounting of each unit. It is an outline showing how you will distribute the topics and the time to ensure that students are prepared to comply with the requirements of the subject.
- This outline should show how you will develop the teaching of the subject. It should reflect the individual nature of the course in your classroom and should not just be a “copy and paste” from the subject guide.

If you will teach both higher and standard level, make sure that this is clearly identified in your outline.

	Topic/unit (as identified in the IB subject guide) <i>State the topics/units in the order you are planning to teach them.</i>	Contents	Allocated time		Assessment instruments to be used	Resources <i>List the main resources to be used, including information technology if applicable.</i>
			One class is <input type="text"/> minutes.	In one week there are <input type="text"/> classes.		
Year 1	Algebra 1.2 and 1.3	Exponents and Logarithms - Simplifying expressions, laws of exponents and logs, and change of base. Binomial theorem with application of Pascal's triangle and "n" choose "r" with and without technology.	10 hours		Weekly quizzes. Unit quizzes and test. Projects	SDUHSD Math 3 Honors curriculum. Stewart Calculus and supplemental materials.
	Algebra 1.5, 1.6, 1.7	Complex numbers: a+bi form, a= real, b = imaginary, and conjugate pairs and the relations. Sums, difference, products, and quotients of complex numbers. Use technology to estimate value. The complex plane and graphing complex numbers. The polar form of complex numbers. Sums, differences, products, and quotients of complex numbers in polar form. Powers of complex	10 hours			

		numbers (de Moivre's theorem) and nth roots of a complex number.			
	Algebra 1.8 and Functions and Equations 2.5, 2.6, 2.7	Polynomial functions (Including quadratic) and their graphs: end behavior, roots, conjugate roots (polynomials with real coefficients), multiplicity, "shape" at zeros as multiplicity increases (even vs. odd), the factor and remainder theorem, long division vs. synthetic division, the fundamental theorem of algebra, quadratic formula, use of the discriminant, find solutions to $g(x) = f(x)$, $g(x) > f(x)$, $g(x) < f(x)$, $g(x) \leq f(x)$, $g(x) \geq f(x)$ graphically, numerically, and algebraically, and be able to use technology (graphing calculator and computer software) to analyze a polynomial function. Sum and product of the roots of polynomial equations.	18 hours		
	Algebra 1.9	Solutions of systems of equations up to three equations and three unknowns (unique, infinite, and no	8 hours		

		solutions) using substitution and/or elimination methods algebraically. Be able to solve a system by constructing a matrix and using technology to reduce and solve matrix.			
	Functions and Equations 2.1, 2.2, 2.3, 2.4	Students are able to recognize, graph, and analyze the parent functions and transformations (translations, stretches and reflections) of the below parent functions: constant, identity, linear, quadratic, square root, cube root, absolute value, cubic, cube root, reciprocal, rational, greatest integer, exponential, logarithmic, sine, cosine, tangent, cosecant, secant, and cotangent. Students will be able to Analyze functions graphically and algebraically: domain, range, odd/even function, composite functions, inverse function, turning points (relative maximum/minimum values), intercepts, horizontal/vertical asymptotes, symmetry	10 hours		
	Functions and Equations	Students will be able to	8 hours		

2.1	<p>understand the concept of function and its notations with respect to: $f(x)$, $f: x \mapsto f(x)$, function composition, function combinations, inverse functions, domain restrictions. Algebraic function justification of inverse functions and even/odd functions.</p>			
Circular Functions and Trigonometry 3.1	<p>Students will use right triangle trigonometry to justify/illustrate the radian measure of angles, length of an arc and area of a sector. These will then be generalized to all circle with any radius measure and then the specific case of a circle with a radius measure of one will be explored.</p>	25 hours		
Circular Functions and Trigonometry 3.2, 3.3,3.7	<p>Students will be able to: define $\cos \theta$, $\sin \theta$ and $\tan \theta$ in terms of a unit circle. Know exact values of sine, cosine and tangent for angle measures of: $0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}$ and their multiples. Students will know and understand the definition of the reciprocal trigonometric identities ($\sec \theta$, $\csc \theta$ and $\cot \theta$), pythagorean identities ($\sin^2 \theta + \cos^2 \theta = 1$)</p>			

		<p>π), compound angle identities, double angle identities, The Law of Sines, and the Law of Cosines and the trig area of a triangle formula.</p>			
	<p>Circular Functions and Trigonometry 3.3-3.6</p>	<p>Students will explore the composite functions in the form of $f(x) = a \sin(b(x+c)) + d$ as well as the graphs of inverse functions and their domains and ranges. Students will be proficient in solving trigonometric equations algebraically and graphically.</p>			
	<p>Statistics and Probability 5.1-5.7</p>	<p>Concepts of population and sampling. Examining grouped data and mean, variance, and standard deviation. Concepts of trial, outcomes, sample space and even. Students will explore probability and look at complementary events, combined events, mutually exclusive events. Students will know the definition of conditional probability and probability of independent events. Students will work with concepts of probability distributions, binomial</p>	<p>36 hours</p>		

		distribution, poisson distribution, and normal distribution.			
Year 2	Algebra 1.1	Sequences and Series, Sigma Notation and Applications	6 hours		
	Algebra 1.4	proof by Mathematical Induction	2 hours		
	Vectors 4.1-4.7	Student will understand the concept of a vector, representation of vectors using directed line segments, unit vectors, base vectors, components of a vector, as well as operations of vectors algebraically and geometrically. Students will know the definition of the scalar product of two vectors and the properties of the scalar product, the angle between two vectors, and perpendicular and parallel vectors. Vector equation of a line into two and three dimensions, simple applications to kinematics and the angle between two lines. Distinguishing between coincident, parallel, intersecting, and skew lines and points of intersection. The	24 hours		

		<p>definition of the vector product of two vectors. Vector equation of a plane. Intersections of a line with a plane(s) and angle between a line and a plane or two planes.</p>			
	<p>Calculus 6.1-6.7</p>	<p>Limits, continuity and convergence. Limit definition of the derivative. Derivative defined as a gradient function and as a rate of change. Equations of tangents and normals. Intervals of increasing and decreasing. Second and higher derivatives. Derivatives of all families of functions. Power rule, product rule, quotient rule and change rule for derivatives. Related rates of change and implicit differentiation. Using calculus to find maximum and minimum values, points of inflections and the graphical behaviors of a function and the graphs of the derivatives of the function. Optimization problems. Indefinite integration as anti-differentiation. Anti-differentiation as a family of</p>	<p>48 hours</p>		

		<p>curves as well as using a boundary condition to determine the constant of integration. Definite integrals. Areas of region enclosed by curves. Volumes of revolution about the x-axis or y-axis. Kinematic problems involving displacement, velocity, acceleration, and total distance travelled. Integration by substitution and by parts.</p>			
	<p>Calculus 9.1-9.7</p>	<p>Infinite sequences of real numbers and their convergence and divergence. Convergence of infinite series by applying the various Tests for Convergence. Exploring the different types of series, including p-series and alternating series. Determining if a series converges absolutely or conditionally. Radius and interval of convergence for power series by application of the ratio test. Taylor polynomials and the Lagrange form of the error term. Maclaurin series and the use of substitution, products,</p>	<p>48 hours</p>		

		<p>integration and differentiations to obtain other series.</p> <p>Continuity and differentiability of a function at a point.</p> <p>Continuous functions and differentiable functions. The integral as a limit of a sum. The fundamental theorem of calculus. Improper integrals. In the topic of differential equations, looking at slope fields, numerical solutions, euler's method, solutions to separable differentials. Taylor series developed from differential equations. Rolle's Theorem and Mean Value theorem. Evaluation of limits and using l'Hopital's rule or Taylor series to evaluate limits.</p>			
	Mathematical Exploration		10 hours		

2. IB internal assessment requirement to be completed during the course

Briefly explain how and when you will work on it. Include the date when you will first introduce the internal assessment requirement to your students, the different stages and when the internal assessment requirement will be due.

Student will first be introduced to their internal assessment during the second semester of year 1. Students will then be required to state their thesis topic by the end of year 1. Students will need to have a first draft done by the end of the first semester year 2 with their final draft due in February.

3. Links to TOK

You are expected to explore links between the topics of your subject and TOK. As an example of how you would do this, choose one topic from your course outline that would allow your students to make links with TOK. Describe how you would plan the lesson.

Topic	Link with TOK (including description of lesson plan)
Series	Students will look at how mathematics often appears in nature. Specifically exploring π , e , ϕ , and Fibonacci numbers and how this may connect to mathematical knowledge.
Functions	Is the same rigor of mathematics required to look at a function graphically, numerically, algebraically, and/or analytically?
Trigonometric Equations	Students will discuss how there can be an infinite number of discrete solutions to an equation?

4. Approaches to learning

Every IB course should contribute to the development of students' approaches to learning skills. As an example of how you would do this, choose one topic from your outline that would allow your students to specifically develop one or more of these skill categories (thinking, communication, social, self-management or research).

Topic	Contribution to the development of students' approaches to learning skills (including one or more skill category)
Exponential Functions	How is the term "exponential growth" used in real life? Is this a misleading use of a mathematical term to describe such phenomena?
Vectors	Students will look at the various applications of vectors in the real world and how the application of navigation can be for the better good or for bad. They can be used to guide someone that is lost or be used to determine the location of where a bomb will land.

Statistics	Does the use of statistics lead to an overemphasis on attributes that can easily be measured over those that cannot?
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5. International mindedness

Every IB course should contribute to the development of international-mindedness in students. As an example of how you would do this, choose one topic from your outline that would allow your students to analyse it from different cultural perspectives. Briefly explain the reason for your choice and what resources you will use to achieve this goal.

Topic	Contribution to the development of international mindedness (including resources you will use)
Binomial Theorem	Students will look at all the properties of Pascal's triangle and explore how they were used/known in different cultures long before Pascal's time.
Functions	When and where was the idea of function notation developed and how did it become accepted today internationally?
Trigonometry	Students will explore how degrees originated in Mesopotamia and why we use minutes and seconds for times.

6. Development of the IB learner profile

Through the course it is also expected that students will develop the attributes of the IB learner profile. As an example of how you would do this, choose one topic from your course outline and explain how the contents and related skills would pursue the development of any attribute(s) of the IB learner profile that you will identify.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
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Calculus	Students are reflective as they learn the topic of calculus. They are able to look at their foundational skills that have prepared them in understanding the concepts of calculus. They are also inquirers as they explore how and why calculus was developed.
Statistics	Students are thinkers as they look at data and how it drives decisions they make as a student and decisions made in the world around them.
Functions	Students will display open-mindedness as they discuss analyzing functions graphically, numerically, and algebraically. They will look at if and when one form is better or more accessible than the other and are there times when one is not appropriate. Are all forms of a function equally as rigorous as the other?

7. Resources

Describe the resources that you and your student will have to support the subject. Indicate whether they are sufficient in terms of quality, quantity and variety. Briefly describe what plans are in place if changes are needed.

The resources for the students include our district's Integrated Math Curriculum, our district's Student Support Website, and the curriculum for our AP Calculus AB and BC Classes, AP Statistics, Calculus D and Linear Algebra Course. If this is not sufficient, students and teachers have available resources on the internet.