Curriculum overview for MATHEMATICS, SL, **4mn, School Year 2019/2020**

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Unit title / Month	Concept(s)	Content	Objectives/ Learning outcomes	Assessment tasks	ATL skills	Links to other subjects
Statistics and Probability Topic 5 5.5, 5.6 Sept. (4 weeks)	Representation, relationships, quantity, approximation, generalization	**Topics:** •Concepts of trial, outcome, equally likely outcomes, sample space, event •The probability of an event •The complementary events •Independent events •Combined events •Conditional probability •Probabilities with and without replacement **Skills:** •To use Venn diagrams, tree diagrams and tables of outcomes •To use experiments with coins, dice, cards to enhance understanding of the distinction between (experimental) relative frequency and (theoretical) probability	•Knowledge and understanding •Problem solving •Communication and interpretation •Technology •Reasoning •Inquiry approach	•Progress test •Quizz	•Communication skills (understand, use and interpret math.notation) •Thinking-critical thinking skills (use models and simulations to explore issues: applying in real-life contexts,recognize and evaluate propositions for general laws, draw reasonable conclusions and generalizations and test them: evaluate evidence and arguments	**Aim 8(moral, social and ethical implications):** The gambling issue: use of probability in casinos. Could or should mathematics help increase incomes in gambling? **Appl**: Use of probability methods in medical studies to assess risk factors for a disease **TOK:** Mathematics and knowledge claims. Is independence as defined in probabilistic terms the same as that found in normal experience?
Calculus	Change, patterns, relationships,	**Topics:**	•Knowledge and understanding	•Progress tests	•Communication skills (use and interpret	**Appl:** Economics 1.5 (marginal cost,

Topic 6 Oct., Nov., Dec. (11 weeks)	approximation, generalization, modelling, systems, quantity	•Informal ideas of limit and convergence. •Definition of derivative as limit •Rules of differentation: sum, product, quotient, chain •Testing for maximum/ minimum •Points of inflexion •Graphical behaviour of functions •Relationships between the graphs of functions and its derivatives •Optimization problems •Indefinite integral, anti-differentiation •Integration by substitution •Definite integrals •Area under a curve •Kinematics •Volumes of solids **Skills:** •To find derivative from the first principle •To find equations of tangents and normals •To graph functions by applying derivatives •To find the area between curves, algebraically/ GDC •To find volumes of revolution •To solve kinematics problems	•Problem solving •Communication and interpretation •Technology •Reasoning •Inquiry approach	•Unit test •Quizzes •Semester exam	discipline-specific terms and symbols; •Social-collaboration (work collaboratively) •Self-management-organisation skills (bring necessary equipment to class; GDC) •Reflection (identify strengths and weaknesses of personal learning strategies) •Research •Information literacy (use memory techniques to develop long term memory - rules for differentiation and integration •Thinking-critical thinking skills (Identify obstacles and challenges) •Thinking-research (make connections between subject groups and disciplines)	marginal revenue, marginal profit) **International-mindedness**: How the Greeks distrust of zero meant that Archimedes' work did not lead to calculus. **TOK**: What does the dispute between Newton and Leibnitz tell us about human e motion and mathematical discovery? **TOK**: What value does the knowledge of limits have? Is infinitesimal behaviour applicable to real life? **Appl:** Physics (kinematics) **Appl:** profit

Exploration Jan. (3 weeks)	Representation, modelling, patterns, evaluation	**Topics:** Within syllabus or extensions of syllabus	•Knowledge and understanding •Problem solving •Communication and interpretation •Technology	Internal assesment	•Self-management-organisation skills •Research skills •Information literacy •Communication skills •Mathematical presentation •Personal engagement •Reflection skills •Use of mathematics	Applications, technology, moral, social and ethical implications, the international dimension
Statistics and Probability Topic 5 5.7, 5.8, 5.9 Feb. (4 weeks)	Generalization, representation, modelling, equivalence, patterns, quantity validity	**Topics:** •Concept of discrete and continuous random variables and their probability distributions •Expectation, mode, median and standard deviation •Binomial distribution, its mean and variance •Normal distribution •Properties of the normal distribution •Standardization of normal variables **Skills:** •To recognise and use appropriate probability density functions in real-life situations •To apply normal distribution on different problems	•Knowledge and understanding •Problem solving •Communication and interpretation •Technology •Reasoning •Inquiry approach	•Progress test •Unit test •Quizz	•Thinking-critical thinking skills (use models and simulations to explore complex issues •Social-collaboration •Thinking-research (make connections between disciplines, phychology, economy) •Comunication-the ability to formulate one's arguments, in speaking or writing, in a convincing manner	**Appl:** Psychology, Biology (statistical analysis). **Aim 8(moral, social and ethical implications):** Why might the misuse of the normal distribution lead to dangerous inferences and conclusions? **TOK:** Mathematics and the real world. Is the binomial distribution ever a useful model for an actual real-world situation **Appl:** Expected gain to insurance companies.

Vectors Topic 4. March, April (5 weeks)	Generalization, space, relationships, equivalence, representation, modelling, patterns	**Topics:** •Concept of a vector •Operations with vectors •Scalar product of two vectors •Vector equation of a line •Coincident, parallel, intersecting and skew lines •Points of intersection **Skills:** •To find unit vectors, magnitude and position vectors graphycaly and in coordinate form •To find the angle between two vectors, perpendicular and parallel vectors •To transform from parametric to Cartesian form of line •To find the angle between two lines •To apply vectors on finding areas of triangles and parallelograms •To geometricaly interpret the solutions	•Knowledge and understanding •Problem solving •Communication and interpretation •Reasoning •Inquiry approach	•Progress test •Unit test •Quizzes	•Communication skills (to use graphical representation to understand relationships) •Thinking - transfer (apply skills in unfamiliar situations) •Social-collaboration (work collaboratively in teams during group work) •Thinking-critical thinking skills (use models to explore complex systems)	**Appl:**Physics **TOK:** The nature of mathematics. Why this definition of scalar product? **Aim 8:** Vector theory is used for tracking displacement of objects, including for peaceful and harmful purposes. **TOK** Are algebra and geometry two separate domains of knowledge? Why are symbolic representations of three-dimensional objects easier to deal with than visual representations?
Course review April (2 weeks)	Representation, Evaluation, Quantity	**Syllabus**	•Knowledge and understanding •Problem solving •Communication and interpretation •Reasoning	Year exam	•Self-management-organisation skills •Thinking-critical thinking skills •Communication skills •Social-collaboration (organize learning groups)	

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Unit title / Month	Concept(s)	Content	Objectives/ Learning outcomes	Assessment tasks	ATL skills	Links to other subjects
CORE Statistics and Probability Topic 5 5.3, 5.4 Sept. (3 weeks)	Representation, relationships, quantity, approximation, generalization	**Topics:** •Independent events; •Combined events •Conditional probability •Bayes' Formula **Skills:** •To use Venn diagrams, tree diagrams and tables of outcomes •To apply Bayes fomula on real life situations	•Knowledge and understanding •Problem solving •Communication and interpretation •Technology •Reasoning •Inquiry approach	•Progress test •Quizz	•Communication skills (understand, use and interpret math.notation) •Thinking-critical thinking skills (use models and simulations to explore issues: applying in real-life contexts,recognize and evaluate propositions for general laws, draw reasonable conclusions and generalizations and test them: evaluate evidence and arguments	**Appl**: Use of probability methods in medical studies to assess risk factors for certain diseases. **TOK:** Mathematics and knowledge claims. Is independence as defined in probabilistic terms the same as that found in normal experience?
Calculus Topic 6 Oct., Nov. (9 weeks)	Change, patterns, relationships, approximation, generalization, modelling, systems, quantity	**Topics:** •Informal ideas of limit and convergence. •Definition of derivative as as limit •Derivative interpreted as gradient function and as rate of change •Rules of differentation: sum, product, quotient, chain •Testing for maximum/ minimum	•Knowledge and understanding •Problem solving •Communication and interpretation •Technology •Reasoning	•Progress tests •Unit test •Quizzes	•Communication skills (use and interpret discipline-specific terms and symbols; •Social-collaboration (work collaboratively) •Self-management-organisation skills (bring necessary	**TOK:** The nature of mathematics. Does the fact that Leibniz and Newton came across the calculus at similar times support the argument that mathematics exists prior to its discovery?

		• Points of inflexion • Graphical behaviour of functions • Relationships between the graphs of functions and its derivatives • Optimization problems • Indefinite integral, anti-differentiation • Integration by substitution and by parts • Definite integrals • Area under a curve • Kinematics • Volumes of solids **Skills:** • To find derivative from the first principle • To find equations of tangents and normals • To graph functions by applying derivatives • To find the area between curves, algebraically/ GDC • To find volumes of revolution • To solve kinematics problems	• Inquiry approach		equipment to class; GDC) • Reflection (identify strengths and weaknesses of personal learning strategies) • Research • Information literacy (use memory techniques to develop long term memory - rules for differentiation and integration • Thinking-critical thinking skills (Identify obstacles and challenges) Thinking-research (make connections between subject groups and disciplines)	**International-mindedness**: How the Greeks distrust of zero meant that Archimedes' work did not lead to calculus. **TOK**: Mathematics and the knower. What does the dispute between Newton and Leibnitz tell us about human e motion and mathematical discovery? **Appl:** Economics (theory of the firm); Chemistry (graphical techniques), Physics (kinematics)
Statistics and Probability Topic 5 5.5, 5.6, 5.7	Generalization, representation, modelling, equivalence, patterns, quantity validity	**Topics:** • Concept of discrete and continuous random variables and their probability distributions • Expectation, mode, median and standard deviation • Binomial distribution, its mean and variance	• Knowledge and understanding • Problem solving • Communication and interpretation • Technology	• Progress test • Unit test • Quizz • Semester exam	• Thinking-critical thinking skills (use models and simulations to explore complex issues • Social-collaboration • Thinking-research (make connections	**Appl:** Psychology, Biology (statistical analysis). **Aim 8(moral, social and ethical implications):** Why might the misuse of the normal distribution lead to

Dec. (3 weeks)		• Poisson distribution, its mean and variance • Normal distribution • Properties of the normal distribution • Standardization of normal variables **Skills:** • To recognise and use appropriate probability density functions in real-life situations • To apply normal distribution on different problems	• Reasoning • Inquiry approach		between disciplines, phychology, economy) • Comunication-the ability to formulate one's arguments, in speaking or writing, in a convincing manner	dangerous inferences and conclusions? **TOK:** Mathematics and the real world. Is the binomial distribution ever a useful model for an actual real-world situation. Mathematics and knowledge claims. To what extent can we trust mathematical models such as normal distribution? **Appl:** Expected gain to insurance companies.
Exploration Jan. (2 weeks)	Representation, modelling, patterns, evaluation	**Topics:** Within syllabus or extensions of syllabus	• Knowledge and understanding • Problem solving • Communication and interpretation • Technology	Internal assesment	• Self-management-organisation skills • Research skills • Information literacy • Communication skills • Mathematical presentation • Personal engagement • Reflection skills Use of mathematics	Applications, technology, moral, social and ethical implications, the international dimension
Vectors Topic 4. Feb., March	Generalization, space, relationships, equivalence, representation, modelling, patterns	**Topics:** • Concept of a vector • Operations with vectors • Scalar and vector product of two vectors • Vector equation of a line and a plane	• Knowledge and understanding • Problem solving • Communication and interpretation	• Progress test • Unit test • Quizzes	• Communication skills (to use graphical representation to understand relationships)	**Appl:**Physics **TOK:** The nature of mathematics. Why this definition of scalar product?

(5 weeks)		•Coincident, parallel, intersecting and skew lines •Points of intersection of lines and planes •Angle between a line and a plane, two planes **Skills:** •To find unit vectors, magnitude and position vectors graphycaly and in coordinate form •To find the angle between two vectors, perpendicular and parallel vectors •To transform from parametric to Cartesian form of line •To find the angle between two lines •To apply vectors on finding areas of triangles and parallelograms •To geometricaly interpret the solutions	•Reasoning •Inquiry approach		•Thinking - transfer (apply skills in unfamiliar situations) •Social-collaboration (work collaboratively in teams during group work) •Thinking-critical thinking skills (use models to explore complex systems)	**Appl:** Modelling linear motion in three dimensions; Navigational devices (GPS) **TOK:** The nature of mathematics. Why might it be argued that vector representation of lines is superior to Cartesian? **TOK:** Why are symbolic representations of three-dimensional objects easier to deal with than visual representations?
OPTION Discrete mathematics Topic 10.	Generalization, relationships, equivalence, representation, quantity	**Topics:** •Strong induction •Pigeon-hole principle •Division and Euclidean algorithms •Gcd and lcm •The fundamental theorem of arithmetic •Linear diophantine equations *ax+by=c* •Modular arithmetic. Linear congruences	•Knowledge and understanding •Problem solving •Communication and interpretation •Reasoning •Inquiry approach	•Progress test •Unit test •Quizzes •Year exam	•Thinking-critical thinking skills (use models and simulations to explore issues) •recognize and evaluate propositions for general laws, draw reasonable conclusions and generalizations and test them	**TOK:** Mathematics and knowledge claims. The difference between proof and conjecture Proof by contradiction. **Int:** Euclidean algorithm contained in Euclid's Elements, written in Alexandria about 300 BCE. **Aim 8:** Use of prime numbers in

Feb., March, Apr. (7 weeks)		• Chinese remainder theorem • Number systems • Fermat's little theorem. • Graphs, vertices, edges • Handshaking lemma • Euler's relation; theorems for planar graphs • Walks, trails, paths, circuits, cycles • Hamiltonian paths and cycles • Eulerian trails and circuits • Recurrence relations. Recursive definition of a sequence **Skills:** • To use the Euclidean algorithm • To determine the shortest route around a weighted graph going along each edge at least once • To perform Kruskal's and Dijkstra's algorithms • To solve "Chinese postman" and "Travelling salesman" problem • To find solution of first- and second-degree linear homogeneous recurrence relations with constant coefficients			• Communication skills (to use graphical representation to understand relationships)	cryptography. The possible impact of the discovery of powerful factorization techniques on internet and bank security **Int:** Babylonians a base 60 number system and the Mayans a base 20 number system **Aim 8:** Symbolic maps, eg Metro and Underground maps, structural formulae in chemistry, electrical circuits. **Int:** The "Bridges of Königsberg" problem **TOK:** Mathematics and the world. The connections of sequences such as the Fibonacci sequence with art and biology