令和4年度　学習指導予定ならびに進度表

仙台育英学園高等学校　秀光コース		教科	科目	教科書名	週時数	担当者氏名　　印
学年	3	Mathematics Analysis and approaches	HL	Oxford IB Diploma Programme Mathematics Analysis and approaches	6	
組	M1					
系	理系					

・数と式・集合と命題・図形の性質・整数の性質については1年次に履修済み

年	月	予定時数※	unit	授業内容 (Course Content)		課題(Homeworks)	IA準備/最終試験準備	TOKとのつながり	ATLとのつながり
				探究の領域 (Area of Inquiry)	概念 (Concept)				
2020			Introduction*	・About the two-year schedule ・About final examination and Internal Assessment ・Basic usage of scientific calculator				Geometry and trigonometry allow us to quantily the physical world, enhancing our spatial awareness in two and in three dimensions. This topic provides you with the tools for analysis, measurement and transformation of quantities, movements and relationships.	Media Literacy You can use a scientific calculator to find the trigonometric ratio value from an angle. On the contrary, the angle can be obtained from the value of the trigonometric ratio. You can answer questions on Desmos that follow real-life examples. You can use a scientific calculator to draw a graph of trigonometric functions.
	12月	12	From patterns to generalizations:sequences,series and proof ・数列 Relationships in space :geometry and trigonometry* ・図形と計量 ・三角関数	Geometry and trigonometry allow us to quantify the physical world, enhancing our spatial awareness in two and three dimensions. This branch provides us with the tools for analysis, measurement and transformation of quantities, movements and relationships.	Space,Relationships	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.			
	冬季休業								
2021	1月	17							
	2月	17	Statistics and probability* ・データの分析 ・確率分布と統計的な推測	Statistics is concerned with the collection, analysis and interpretation of quantitative data and uses the theory of probability to estimate parameters, discover empirical laws, test hypotheses and predict the occurrence of events. Statistical representations and measures allow us to represent data in many different forms to aid interpretation.	Quantity,Validity	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Probability - uses and abuses The Monty Hall dilemma Probability and intuition the birthday problem Facts and misconceptions in statistics Correlation or causation?	Thinking skills Critical thinking Creativity and innovation Transfer
	3月	15							
	春季休業								
	4月	19	Representing Relationships (Function) ・2次関数 ・関数 ・式と曲線	Function, domain, range ■ Key features of graphs ■ Composite functions ■ The quadratic function ■ Transformations ■ Odd and even functions ■ Partial fractions	Reprsentation,Relationships What kind of relationships exist between two quantities or variables? Is the relationship between runner and water the same as car and fuel? Can shadows be modelled using functions?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Around the world you will often encounter diffrent words forthe same object, like trapezium and trapezoid or root and surd. Sometimes more than one type of symbol might have the same meaning such as interval and set notation. To what extent does the language we use shape the waywe think?	Languages Research one of these concepts, historical developments, applications or paradoxes that result from the existence of infinity.They are all conceptually difficult. You can use both online sources and/or printed resources. Present your ideas to your class.
	GW								
	5月	22	Expanding the number system (Complex Numbers)* ・複素数と方程式 ・式と証明	■ Quadratic function and graph ■ Quadratic equations and inequalities ■ Discriminant ■ ℤomplex numbers ■ Modulus of a complex number ■ Operations with complex numbers ■ Powers and roots of complex numbers ■ Polynomial functions and their graphs ■ Operations on polynomials ■ Linear combination of two polynomials ■ Factor and remainder theorem ■ The fundamental theorem of algebra ■ Polynomial equations ■ Sum and product of the roots of polynomial equations ■ Polynomial inequalities ■ Simultaneous equations	Systems and Patterns Are real numbers the only numbers that "exist"? How do physicists at the Large Hadron Collider at CERN model the smashing of particles? Can you use a polynomial to model the roller coaster?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		How can you deal with the ethical dilemma of using mathematics to cause harm, such as plotting the course of a missile?	Media Literacy Making a Mandelbrot Fractals You may have heard about fractals. The image above is from the Mandelbrot set, one of the most famous examples of a fractal. This is not only a beautiful image in its own right.The Mandelbrot set as a whole is an object of great interest to mathematicians. However, as yet, no practical applications have been found. This image appears to be very complicated, but is in fact created using a remarkably simple rule. How could you find the area or perimeter of the Mandelbrot set?
	6月	16	Measuring Change (Differentiation) ・微分法と積分法	■ Limit of a function at a point ■ Continuity of a function ■ Differentiation from first principles ■ Tangents and normals to curves ■ Differentiation rules ■ Methods of differentiation: chain, product and quotient rules ■ Maxima, minima and points of inflexion ■ Kinematic problems ■ Optimization ■ Implicit differentiation How does the concept of limits help you analyse the problem of finding a runner's speed at a specific instant in time?	Change, Relationship List some sports in which the direction of something changes rapidly –for example, a tennis ball after it is hit. What different inquiry questions might you ask in this situation? For example, how can you determine the speed of the tennis ball before and after it changes direction? How can you determine the time at which the ball changes direction?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Is there always a trade-off between accuracy and simplicity? Does personal experience play a role in the formation of knowledge claims in mathematics? Does it play a different role in mathematics compared to other areas of knowledge?	Reflect Can you think of some other real-life related rates problems? Thinking skills: Evaluate, Critiquing, Applying The problem You are standing at the edge of a slow-moving river which is one kilometre wide. You want to return to your campground on the opposite side of theriver. You can swim at 3 kph and run at 8 kph. You must first swim across the river to any point on the opposite bank. From there you must run to the campground, which is 2 km from the point directly across the river from where you start your swim. What route will take the least amount of time?
	7月	12	Relationships in space (Geometry and Trigonometry) ・三角関数	■ Derivatives of trigonometric functions	Space and Relationship	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Solving an equation has given you an answer in mathematics but, how can an equation have an infinite number of solutions?	Transfer Brainstorm In small groups, brainstorm some ideas that link music and mathematics. Construct a mind map from your discussion with the topic "MUSIC" in the centre. Share your mindmaps with the whole class and discuss.
	夏季休業								
	8月	5							
	9月	19	Generalizing relationships (Exponent, Logarithms and Integration) ・指数関数と対数関数 ・極限	■ Integration as antidifferentiation ■ Analytic approach to areas under curves—Riemann sums ■ Integration of trigonometric functions, polynomial, radical and rational functions ■ Laws of exponents ■ Laws of logarithms ■ Exponential and logarithmic functions and their graphs ■ Solution of exponential equations using logarithms ■ Derivatives of exponential and logarithmic functions ■ Including tangents, normals and optimization ■ Indefinite integrals of exponential functions and 1/x ■ The composites of these with the linear function (ax + b) ■ Integration by inspection, by substitution, by parts ■ Repeated integration by parts	How can you find how much paint is needed to cover a parabolic-shaped door? How much work is needed to stretch a spring a fixed amount? Suppose you know the function that models the rate at which a given item moves along an assembly line in metres per second. How can you finnd a function that models the number of metres the manual is from the start of the assembly line t seconds after it begins moving?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		We are trying to finnd a method to evaluate the area under a curve. "Themain reason knowledge is produced is to solve problems." To what extent do you agree with this statement? Where doesmathematics come from? Galileo said thatthe universe is a grand book written in the language of mathematics. Does it startin our brains oris it part ofthe universe?	Information Literacy Look at the data Fortnite was released by Epic games in July 2017 and quickly grew in popularity. Here are some data for the total number of registered players worldwide from August 2017 to June 2018: The data is taken from the press releases of the developers, Epic Games. • Are these data reliable? • Are there any potential problems with the data that has been collected? • What other data might be useful? Can you collect reliable and relevant data for your example? Find data and present it in a table and a graph. Develop a model or models for the data (ensure that your notation is consistent and your variables are defined)- you could use technology or calculations by hand. For how long do you think your model will be useful for making predictions? Explain.
	10月	22	Analysing data and quantifying Randomness (Correlation) ・データの分析 ・確率分布と統計的な推測	■ Population, sample, discrete and continuous data ■ Sampling: convenience, simple random, systematic, quota, stratified ■ Frequency distributions (tables) ■ Grouped data ■ Histogram ■ Central tendency: mean, mode, median ■ Spread (or dispersion): cumulative frequency, cumulative frequency graphs ■ Median, quartiles, percentiles ■ Range, interquartile range, outliers ■ Box-and-whisker diagrams ■ Skew ■ Standard deviation and variance How would you collect, organize, analyse, represent and interpret the data if you had two data sets? Think about the questions in this opening problem and answer any you can. As you work through the chapter, you will gain mathematical knowledge and skills that will help you to answer them all.	Quantity, Validity How would you collect, organize, analyse, represent and interpret the data if you had two data sets? In the opening problem for the chapter, you were given the test scores, out of 10, of 32 students. • Are the test scores an example of discrete or continuous data? • Before marking every student's test paper, the teacher wishes to choose a sample of eight that will give her an estimate of the mean average mark for the class. Describe a suitable sampling method the teacher could use. Find the mean, mode and median of the class testscores from the start of this chapter. Which of mean, median or mode gives the best	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.	Internal Assessment Introduction	To what extent are theoretical and experimental probabilities linked? What is the role of emotion in our perception of risk, for example in business, medicine and travel safety? The nature of knowing: is there a difference between information and data?	Refect Is the taxiing speed of an airplane discrete or continuous? Is the number of airplanes waiting to take off discrete or continuous? Could data ever be classified as both discrete and continuous? Why is it important to consider the nature of the variable, rather than just the data values themselves, when classifying whether data are discrete or continuous? Collaboration Your teacher will instruct you, in groups, on how to create a selection of different pieces of music. Individually rank the pieces of music you have selected by number, with 1 being the favourite. Record the rankings of everyone in your group. Do not collaborate or communicate with each other. Find the Spearman rank correlation between each pair of students in your group. Do any of the pairs of students display strong correlations? Write a conclusion for this experiment based on the results you have found.
	11月	23							
	12月	10	Generalizing relationships (Integration) ・微分法と積分法	Integration as antidifferentiation ■ Analytic approach to areas under curves—Riemann sums ■ Integration of trigonometric functions, polynomial, radical and rational functions ■ Laws of exponents ■ Laws of logarithms ■ Exponential and logarithmic functions and their graphs ■ Solution of exponential equations using logarithms ■ Derivatives of exponential and logarithmic functions ■ Including tangents, normals and optimization ■ Indefenite integrals of exponential functions and 1/x ■ The composites of these with the linear function (ax + b) ■ Integration by inspection, by substitution, by parts ■ Repeated integration by parts	Relationships, Generalization Suppose you know the function that models the rate at which a given item moves along an assembly line in metres per second. How can you and a function that models the number of metres the manual is from the start of the assembly line t seconds after it begins moving?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.	IA Workshop : Selecting a Topic	We are trying to find a method to evaluate the area under a curve. "The main reason knowledge is produced is to solve problems." To what extent do you agree with this statement?	Critical Thinking Develop a model or models for the data (ensure that your notation is consistent and your variables are defined)- you could use technology or calculations by hand. For how long do you think your model will be useful for making predictions? Explain.
	冬季休業								

2022	1月	20	Modelling Change (Areas, Volume, ODE) ・微分法と積分法	■ Finding the area between two curves using deffnite integration ■ Volumes of revolution about the x- and y-axes ■ Displacement as the integral of the velocity function ■ Total distance as the integral of the absolute value of the velocity function ■ Separable differential equations ■ Homogeneous differential equations ■ Integrating factors ■ Euler's method for solving differential equations ■ L'Hopital's Rule ■ Maclaurin polynomials	Change, Relationship How does your calculator approximate the values of functions such as sine and cosine? How do medical researchers model and predictthe spread of disease?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Is mathematics independent of culture? To what extent are we people aware of the impact of culture on what we they believe or know?	Communication Repeat the experiment on page 368 with another velocity function and initial displacement. Ensure here that all calculations are completed in radians. You could also devise your own problem similar to the one in this task but try to consider a real-life situation. For example, how could you model the movement(displacement, velocity and acceleration) of an elevator or of a 100m runner?
	2月	16							
	3月	13	Modelling 3D Space (Vectors)* ・平面上のベクトル ・空間のベクトル	■Vector represented by directed line segments ■ Position vector ■ Direction vector ■ Magnitude of a vector ■ Unit vector ■ Base vectors i, j and k ■ Components of a vector ■ Addition of vectors ■ Zero vector ■ Multiplication of a vector by a scalar ■ Opposite vector ■ Scalar product of two vectors ■ Angle between two vectors ■ Perpendicular and parallel vectors ■ Vector product of two vectors ■Volume of a parallelepiped ■ Vector equations of lines and planes ■ Intersections between lines and planes ■ How can a 3D character be mapped out and created? ■ How can a fingerprint scanner calculate whether this is the right finnger?	Space and modelling How might vectors be used to understand the scenario of the skier on the slope?	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		When is it ethically correct to provide vector locations? Do you think that there are times when analytical reasoning is easier to use than sense perception when working in three dimensions?	Organizational Skills The problem Three identical squares with length of 1 are adjacent to one another. A line is connected from one corner of the first square to the opposite corner of the same square, another to the opposite corner of the second square and another to the opposite corner of the third square: Find the sum of the three angles α, β and ϕ Explore and write the direct for the problem above.
	春季休業								
	4月	16	Equivalent systems of representation (More Complex Numbers)* ・複素数平面	■ The complex plane■ Modulus-argument (polar) form ■ Euler's form■ Cartesian form■ De Moivre's theorem ■ Sums, products and quotients■ Geometric interpretation ■ Rational exponents ■ Powers and roots of complex numbers What kinds of numbers are used in applications such as electrical engineering and film animation?	Equivalence and Systems	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.		Why is it called the Argand plane and notthe Wessel plane or Gaussian plane? Imagination is one of the ways of knowing in TOK. How does this relate to imaginary numbers?	Creative Thinking Imagination is one of the ways of knowing in TOK. How does this relate to imaginary numbers? for giving one solution of a depressed cubic. How could you obtain the other two solutions once you know this solution? Investigate the discriminant of the cubic formula. Under what condition will this have: three real solutions at least two of which are one real root and two conjugate imaginary roots? three distinct real roots?
	GW								
	5月	20							
	6月	22	Valid comparisons and informed decisions (Probability Distribution) ・確率分布と統計的な推測 ・場合の数と確率	■Axiomatic probability systems ■ Bayes' theorem ■ Discrete random variables and their probability distributions ■ Probability density functions for continuous random variables ■ Mode and median ■ Mean ■ Variance ■ Standard deviation ■ The effect of linear transformations of x ■ Binomial distribution ■ Mean and variance of the binomial distribution ■ Normal distributions and curves ■ Understanding the natural occurrence of the normal distribution ■ Properties of the normal distribution ■ Diagrammatic representation ■ Expected values ■ Normal probability calculations ■Inverse normal calculations	Quantity, Representation How can an understanding of games such as those above help us in real-world situations? Research some common "cognitive biases" that can be overcome through an understanding of statistics and probability	Textbook practice questions and Exam style-questions question circumference. Exercises using exam-style prints.	Last week of July First Draft	Do you rely on intuition to help you make decisions? Is it possible to reduce all human behaviour to a set of statistical data? What does it mean to say that mathematics can be regarded as a formal game lacking in essential meaning?	Interaction The problem A man walks down a long, straight road. With each step he either moves left or right with equal probability. He starts in the middle of the road. If he moves 3 steps to the left or 3 steps to the right, he will fall into a ditch on either side of the road.The aim is to find probabilities related to the man falling into the ditch, and in particular to find the average number of steps he takes before inevitably falling into the ditch. Explore,Calculate, Simulate your findings and share it to class. Once you have a code written you could easily vary the problem. What variations of the problem can you think of? You may also be able to devise your own probability question which you could answer using simulation.
	7月	14							
	夏季休業								
	8月	6				2nd week August Final Copy of IA			
	9月	22	最終試験対策						
	10月	20							