Analysis & Approaches SL

This table records some of the elements of the Analysis & Approaches SL book which are particularly "IB", or which are interesting "features". They are definitely things to look out for, but please do not consider this an exhaustive list.

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Chapter 1: The Binomial Theorem								
Investigation 1	18							Connects the binomial expansion to Pascal's triangle.
Investigation 2	21-22							Explains the formula for the binomial coefficient using combinations.
Investigation 3	22							Allows students to understand the binomial coefficient by studying Pascal's triangle.
Historical note	26	Functions				Sir Isaac Newton		Introduces the idea of a binomial expansion for rational powers.
Chapter 2: Quadratic Functions								
Opening Problem	30		Physics					Parabolic mirror, focal point, law of reflection – this theme is continued in Investigation 4.
Activity 1	30							Conic sections
Investigation 1 Investigation 2	33-34 34							Practical investigation for developing understanding of how graphs relate to the form of a function.
Investigation 3	46-47							Method of second differences
Investigation 4	55-56		Physics					Links the geometric definition of a parabola to its algebraic form. Carries on the theme of the parabolic mirror from the Opening Problem, applying the law of reflection to explain the focal point.
Chapter 3: Functions								
Theory of Knowledge	93		Computer Science				Language: syntax and semantics	Backus-Naur form for the syntax of programming languages. How can you record algebra in digital form?
Chapter 4: Transformations of functions								
Opening Problem	100	Quadratics, Functions						Builds directly on the previous two chapters, constructing a link to transformations.
Chapter 5: Exponential functions								

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Investigation 1	128	Transformation of functions						Builds on from the transformation of functions chapter to give conceptual understanding of the general exponential function.
Investigation 2	138-139	Compound interest						This investigation gives a pre-limits derivation of the natural exponential *e* by considering compound interest compounding at a faster and faster rate.
Historical note	139	Continued fractions				Jacob Bernoulli, Leonhard Euler		Exact representations of the irrational number *e*.

Chapter 6: Logarithms

Theory of Knowledge	156-157		Physics	Scotland		John Napier	Nature of mathematics	Do we invent or discover mathematics? Is mathematics a collaborative effort? Why is pure mathematics important?
Investigation 3	167-168		Music, Physics, Geology, Chemistry					Logarithmic scales are widely used to understand the real world. In this Investigation we explore: musical notes, the Richter scale for earthquakes, the pH scale for acidity, and the decibel scale for sound intensity.

Chapter 7: The unit circle and radian measure

Theory of Knowledge	180-181			Ancient Babylon			The nature of mathematics	Is mathematics natural? What mathematical things are arbitrarily chosen? What are the benefits of global standardisation?
Discussion	186						Trigonometric identities	

Chapter 8: Trigonometric functions

Opening Problem	200	Radian measure						For 40 years, Haese Mathematics has been using the classic real-world example of a light on a Ferris wheel to motivate the study of trigonometric functions.
Historical note	201		Physics			Michael Faraday		Electromagnetic application of the sine wave.
Investigation	206	Transformation of functions						Builds on from the earlier chapter to give conceptual understanding of the general sine function.
Research	215	Modelling (A&I)	Astronomy, Geography			Sir Isaac Newton		Possible Mathematical Exploration such as modelling sunrise and sunset at a particular latitude over time assuming level ground. (This is non-trivial!)
Activity 2	216	Modelling (A&I)	Physics					Hands on activity demonstrating the physical and mathematical properties of a pendulum

Chapter 9: Trigonometric equations and identities

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Exercise 9D q13	240							Derivation of the important identities for (cos x)^2 and (sin x)^2 used in their integration.
Investigation 2	241							Parametric equations are a fun opportunity for exploration.

Chapter 10: Reasoning and proof

Exercise 10A q6	249					Peter Wason		Classic problem of logic.
Exercise 10B q9 Exercise 10C q7 Review set 10B q8	252 255 260							Identifying incorrect steps in proofs is extremely effective in developing conceptual understanding.
Historical note	252			England		Charles Dodgson	Logic	
Exercise 10C q8	255							Students should recognise the difference between deduction and equivalence. This question explores an example used incorrectly in the syllabus (2019).
Theory of Knowledge	256						Definitions, Proof	How do our definitions and our use of words affect proofs and our mathematical understanding? When we assess algebraic solutions, we may allow expressions which are *equal* and are *equivalent* (to a given level of simplicity) but which are not the *same* as the listed solution.
Theory of Knowledge	258-259					Kurt Gödel, Pierre de Fermat	Axioms	What is an axiom? Why are axioms necessary in mathematics?

Chapter 11: Introduction to differential calculus

Theory of Knowledge	271		Physics	Ancient Greece		Zeno of Elea	Paradoxes	
Historical note	275			Ancient Egypt, Ancient Greece, Europe		Democritus, Eudoxus, Archimedes, Johann Bernoulli, Isaac Barrow		

Chapter 12: Rules of differentiation

Opening Problem	286	Transformation of functions						The transformation of functions previously studied can give clues to the relationships between derivative functions.
Investigation 1	286-287	Binomial expansion						Uses first principles and the binomial expansion with integer powers to deduce the derivative of terms of the form a*x^n where n is a positive integer.
Investigation 2	292-293							Leads to the chain rule.

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Investigation 3	295							Leads to the product rule.
Investigation 4 Investigation 5	300 (link) 301 (link)							Leads to the derivative of e^x.
Investigation 6	303 (link)							Leads to the derivative of ln x.
Investigation 7	306							Leads to the derivatives of sin x and cos x.

Chapter 13: Properties of curves

Chapter 14: Applications of differentiation

Theory of Knowledge	359		Physics			Ibn Sahl, Willebrord Snellius, René Descartes		
Activity	360-361		Graphic Design, Engineering					Cubic splines are a popular and useful modelling tool.

Chapter 15: Introduction to integration

Opening Problem	366		Physics			Archimedes		We begin the study of integration by following its historical development.
Investigation 1	368	Series, Limits						Using series formulae, we prove Archimedes' result for the area under $y = x^2$ on the interval $0 < x < 1$.
Historical note	369			Italy		Bonaventura Cavalieri		
Historical note	370					Sir Isaac Newton, Gottfried Wilhelm Leibniz, Bernhard Riemann	Parallel development	The progression from Archimedes to modern calculus was only possible with the introduction of limits.
Exercise 15B q3	371							Links to the standard normal deviation and the proportion of data within 3 standard deviations of the mean.

Chapter 16: Techniques for Integration

Exercise 16A	383-384							This Exercise is built as an Investigation leading to the rules of integration.

Chapter 17: Definite Integrals

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Activity 2	418-419	Probability				Georges-Louis Leclerc, Comte de Buffon		First historical application of calculus to probability.

Chapter 18: Kinematics

Discussion	427	Vectors	Physics					From the outset, students can discuss the terminology they have for motion, and how the physics and mathematics relate.
Investigation	443-444	Vectors	Physics	England, Italy		Galileo Galilei	Ethics	The study of projectile motion was driven by its applications in war. Does this negate the virtue of its study?

Chapter 19: Bivariate statistics

Historical note	455					Karl Pearson, Sir Francis Galton		
Activity 2	468			England		Francis Anscombe		
Theory of Knowledge	469-470		Biology, Environmental Science	Japan, Global			Modelling	
Theory of Knowledge	474				Equality and Discrimination		Equality	

Chapter 20: Discrete random variables

Activity	491				Game strategy			
Investigation 1 Investigation 2	495 498							Use of technology to investigate the binomial distribution.

Chapter 21: The normal distribution

Historical note	510					Carl Friedrich Gauss		
Investigation 4	527							The normal approximation to the binomial distribution.