Core Topics HL

This table records some of the elements of the Core Topics HL 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: Straight lines								
Opening Problem	20	Voronoi diagrams (A&I)						From the very first problem, we lay the foundation for A&I Voronoi diagrams.
Exercise 1C q9	28	Voronoi diagrams (A&I)						
Chapter 2: Sets and Venn diagrams								
Opening Problem	34		Social studies	Global				Takes a familiar topic and encourages deeper analysis in the global context of the Human Development Index (HDI).
Theory of Knowledge	39-40	Proof by contradiction (A&A)					Proof	
Chapter 3: Surds and exponents								
Opening Problem	54		Physics	England		Sir Joseph John Thomson		Nobel Prize winner in Physics 1906, subatomic particles
Investigation	55	Proof by equivalence (A&A)						
Exercise 3E q11	68		Astronomy					Astronomical distances
Discussion	68			Asia	Mahjong			
Chapter 4: Equations								
Text	76	Proof (A&A)						Identifying errors in worked solutions has been shown to be an important tool for conceptual understanding.
Historical note	79			Europe, Middle East, India				The development of the quadratic formula
Discussion	87				Technology			In a world of technology, there is still purpose to analytic methods and conceptual understanding.

Chapter 5: Sequences and series

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Opening Problem	90			Middle East, India	Legend, Chess	Ibn Khallikān		Famous problem
Exercise 5F q8 Exercise 5F q9	113 114							Building blocks for Chapter 6, Investigation 2.
Theory of Knowledge	118-119						Proof	
Exercise 5H q15	122		Economics					Extends students' understanding to generate a general formula for loan repayments.
Theory of Knowledge	125			Germany		Leopold Kronecker	Infinity	
Activity 4	126 (link)	Affine transformations (A&I)		Sweden		Helge von Koch		A&I students explore the generation of this curve as iterations of a set of affine transformations.

Chapter 6: Measurement

Investigation 1	136-137			Ancient Greece		Archimedes		Archimedes' proof for the formula for the surface area of a sphere.
Investigation 2	144-146	Series, Calculus		Ancient Greece		Archimedes		Uses series to develop volume formulae in a pre-calculus spirit. Essentially uses infinitessimals in the same manner as Archimedes. Comparison with Archimedes' method for deriving the formula for the volume of a sphere (but argued through cross-sectional area rather than physical moment). Little known connection between the surface area and volume of a sphere used a set of tapered solids to approximate the sphere. Possible Paper 3 question.
Project	149-150	Approximation & Estimation (A&I), Modelling (A&I)						Compares numerical methods for the approximation of a real-world problem. Highlights the importance of clearly defining and articulating the problem that is to be solved. Could also be done as the "inverted" problem of lakes. Possible Mathematics Exploration.

Chapter 7: Right angled triangle trigonometry

Theory of Knowledge	158-159		Astronomy	China		Li Chunfeng	Observation, belief, parallel subject development	

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Exercise 7B q7	164							On first inspection, this appears to be a deductive geometry question. We train problem solvers by challenging them to think in different ways.
Exercise 7D q23	173	Scientific notation	Astronomy	Prussia		Friedrich Wilhelm Bessel		1838 measurement of the parallax of the star 61 Cygni.
Research	178-179		Physics	Global	Time			Possible Mathematics Exploration or Extended Essay.
Research	179		Astronomy	Global	Navigation	Hipparchus		Possible Mathematics Exploration or Extended Essay.

Chapter 8: The unit circle and radian measure

Theory of Knowledge	189-190			Ancient Babylon			The nature of mathematics	Is mathematics *natural*? What mathematical things are arbitrarily chosen? What are the benefits of global standardisation?
Discussion	195						Identities	

Chapter 9: Non-right angled triangle trigonometry

Cosine rule proof	212	Proof by exhaustion (A&A)						Most "proofs" of the cosine rule skip the comment about the acute angles in an obtuse angled triangle.
Investigation 1	216							Practical, hands-on investigation of the sine rule
Investigation 2	218							Practical, hands-on investigation of the ambiguous case of the sine rule
Exercise 9D q20 Exercise 9D q21	225 226							Combines real-world application and problem solving skills in 3-dimensional problems.
Theory of Knowledge	226-227			Ancient Greece, India		Hipparchus, Eratosthenes	Subject development, protection of knowledge	Explores motivations for subject development, and the place of historical work in the modern subject. Compares spherical and planar triangles. Why did a "flat Earth" theory persist for so long?
Activity	227-228							Develops the formula for the area of a spherical triangle.
Review Set 9B q15	232	Proof (A&A)		Ancient Greece		Heron		Develops Heron's formula for the area of a planar triangle.

Chapter 10: Points in space

Theory of Knowledge	243-244		Physics	Ancient Greece		Euclid	Axioms, definitions, multi-dimensional space	Explores Euclid's postulates as a basis for planar geometry. Poses serious questions about what we may consider as intuitive, such as straightness and direction. This becomes necessary for exploring space-time as needed for advanced Physics.

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Chapter 11: Probability								
Opening Problem	248		Insurance					Real-world probability application
Investigation 1 Investigation 2	250 250-251							Practical, hands-on investigations. Understanding the role of experimental probability.
Activity 1	274 (link)			Hungary		George Pólya		Pólya's urn is a curious, paradoxical statistical model.
Activity 2	278			USA		Steve Selvin		The Monty Hall problem is one of the best known mathematical paradoxes. This Activity uses tree diagrams to explore the paradox, giving deep understanding of *why* the contestant should change their original guess.
Activity 3	278 (link)			USA		Walter Penney		Penney's Game is a classic mathematical paradox involving cyclic dominance. This advanced Activity explores Penney's Game using tree diagrams. Logic is needed to explain why some points on the tree are equivalent to others. Possible Mathematical Exploration.
Historical note	280					Thomas Bayes, Pierre-Simon Laplace		
Theory of Knowledge	283-284			Europe, USA	Ethics	Blaise Pascal, Pierre de Fermat, Agner Krarup Erlang, Edward Oakley Thorp	Mathematical intuition, decision making, ethics	
Chapter 12: Sampling and data								
Discussion	291-292							Highlights the importance of specifically describing what we are investigating in a statistical experiment.
Discussion	298-299		Politics	United Kingdom, EU				Explores the mathematics of the "Brexit" referendum.
Theory of Knowledge	299-300		Medicine		Ethics		Ethics in research.	Applications in medical trials and social media.
Chapter 13: Statistics								
Theory of Knowledge	322-323						Definitions	How do we decide which description or "definition" of centre to apply in a particular situation?
Investigation 3	351-352							Develops formulae for the mean and standard deviation of the linear transformation of a variable.
Investigation 4	352-353							Allows students to develop an understanding of the two statistics for standard deviation: the sample standard deviation s, and the population standard deviation σ.

	Page	Topic link	Subject link	International link	Cultural link	Historic link	TOK link	Comments
Chapter 14: Quadratic functions								
Opening Problem	360		Physics					Parabolic mirror, focal point, law of reflection – this theme is taken up in a later Investigation.
Activity 1	360							Conic sections
Investigation 1 Investigation 2	363 363							Practical investigations for developing understanding of how graphs relate to the form of a function.
Investigation 3	375-376							Method of second differences
Investigation 4	384-385		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 15: Functions								
Theory of Knowledge	420-421		Computer Science				Language: syntax and semantics	Backus-Naur form for the syntax of programming languages. How can you record algebra in digital form?
Chapter 16: Transformations of functions								
Opening Problem	426	Quadratics, Functions						Builds directly on the previous two chapters, constructing a link to transformations.
Chapter 17: Trigonometric functions								
Opening Problem	448	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	449		Physics			Michael Faraday		Electrical application of the sine wave.
Investigation	454	Transformation of functions						Builds on from the previous chapter to give conceptual understanding of the general sine function.
Research	463	Modelling (A&I)	Astronomy, Geography					Possible Mathematical Exploration such as modelling sunrise and sunset at a particular latitude over time assuming level ground. (This is non-trivial!)
Activity 2	464	Modelling (A&I)	Physics					Pendulum