Wah Yan College Kowloon
F.4 Mathematics M2 Scheme of Work (2017-2018)

Textbook	1. NSS Mathematics in Action Extended Part: Module 2 Volume 1
Other Resources	

◆Repertoire of Self-directed Learning Skills:

1. reading to learn, 2. notes-taking, 3. looking up words in the dictionary, 4. pre-lesson preparation, 5. group discussion, 6. group presentation, 7. initiative to ask questions, 8. setting learning objectives and doing reflection, 9. eLearning platform with instant feedback, 10. flipped classroom, 11. peer assessment, 12. searching for information on the internet, 13. project learning, 14. training of higher-order thinking skills, etc.

SL: Scheduled number of lessons
AL: Actual number of lessons

School Term	Weeks	Topics	Learning Objectives/ Teaching Focus	SL/AL	Teaching and Learning Activities	Consolidation and Assessment	Self-directed Learning Skills◆	Values#	Basic Law Education
First Term (3/9/2017-30/12/2017, Weeks 1-17)	1-3	***Chapter 0 Pre-requisite Knowledge***	I. Set Notation • Recognise set notation. • Define different intervals by sets. Teachers may explain to students why they should understand set notations.	1					
			II. Absolute Value	1	Example 1, Teaching Example 1				

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			• Recognise the definition of absolute value. • Recognise the properties of absolute value. The absolute value function will be further discussed in Volume 2 Chapter 7.						
			III. Summation Notation • Understand the summation notation. • Understand the properties of the operations of summation notation. Students should be aware of the index of summation, the lower and the upper limits of summation.	1	Example 2, Teaching Example 2, Example 3, Teaching Example 3, Example 4, Teaching Example 4	Exercise A (p. 0.10) Level 1: 1 – 5 Level 2: 6 – 9			
			IV. Methods of Proof • Understand the concepts of proposition, conditional	2	Example 5, Teaching Example 5, Example 6,	Exercise B (p. 0.17) Level 1: 1 – 8 Level 2: 9 – 13			

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			proposition, biconditional proposition, sufficient condition, necessary condition and necessary and sufficient condition. • Learn how to perform direct proof, and indirect proof including proof by contrapositive and proof by contradiction. For average or less-able students, teachers may skip this section.		Teaching Example 6, Example 7, Teaching Example 7, Example 8, Teaching Example 8				
	4-5	***Chapter 1 Surds***	1.1. Basic Knowledge of Surds • Learn the definition and the properties of surds. • Simplify an expression involving surds by addition, subtraction and multiplication. When teaching addition and subtraction of like surds,	1	Example 1.1, Teaching Example 1.1, Example 1.2, Teaching Example 1.2, Example 1.3, Teaching Example 1.3, Example 1.4, Teaching	Exercise 1A (p. 1.7) Level 1: 1 – 13 Level 2: 14 – 27 Rev. Ex. 1 (p. 1.14) Level 1: 1 – 8 Level 2: 19 – 22			

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			teachers may remind students of some similar mathematical manipulations, e.g. combining like terms of polynomials.		Example 1.4, Teaching Example 1.4 (Extra)				
			1.2. Rationalization • Rationalization of surds in the form $\frac{k}{\sqrt{a}}$. • Rationalization of surds in the form $\frac{k}{\sqrt{a} \pm \sqrt{b}}$. Teachers can remind students of the identity $a^2 - b^2 \equiv (a + b)(a - b)$ before introducing rationalization of surds.	2	Example 1.5, Teaching Example 1.5, Example 1.6, Teaching Example 1.6, Example 1.7, Teaching Example 1.7, Example 1.8, Teaching Example 1.8, Teaching Example 1.8 (Extra) **5-Minute Lecture:** Surds in the	Exercise 1B (p. 1.11) Level 1: 1 – 16 Level 2: 17 – 28 Rev. Ex. 1 (p. 1.14) Level 1: 9 – 18 Level 2: 23 – 33			

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					form $\frac{k}{\sqrt{a} \pm \sqrt{b}}$				
	5-8	***Chapter 2 Mathematical Induction***	2.1. Principle of Mathematical Induction Understand the principle of mathematical induction. Teachers should introduce the domino effect and compare it with the mechanism of mathematical induction.	1	**5-Minute Lecture:** Principle of mathematical induction				
			2.2. Performing Proofs by mathematical Induction • Learn to prove propositions involving summation of finite sequences. • Learn to prove propositions involving divisibility of integers.	7	Example 2.1, Teaching Example 2.1, Example 2.2, Teaching Example 2.2, Example 2.3, Teaching Example 2.3, Example 2.4,	Exercise 2A (p. 2.12) Level 1: 1 – 11 Level 2: 12 – 25 Exercise 2B (p. 2.20) Level 1: 1 – 10 Level 2: 11 – 24 Rev. Ex. 2 (p. 2.22)			

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			Teachers should emphasize the correct steps of using the principle of mathematical induction.		Teaching Example 2.4, Example 2.5, Teaching Example 2.5, Example 2.6, Teaching Example 2.6, Example 2.7, Teaching Example 2.7, Example 2.8, Teaching Example 2.8, Example 2.9, Teaching Example 2.9, Teaching Example 2.9 (Extra), Example 2.10, Teaching Example 2.10 5-Minute	Level 1: 1 – 10 Level 2: 11 – 27			

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					Lecture: Prove propositions involving summation of finite sequences **5-Minute Lecture:** Prove propositions involving divisibility				
	9-10	***Chapter 3 Binomial Theorem***	3.1 The Notations *n*! and C_r^n • Understand the meaning of *n*!. • Understand the meaning of C_r^n. Teachers may mention why the definition 0! = 1 is made.	0.5	Example 3.1, Teaching Example 3.1, Example 3.2, Teaching Example 3.2, Example 3.3, Teaching Example 3.3, Example 3.4, Teaching Example 3.4,	Exercise 3A (p. 3.8) Level 1: 1 – 13 Level 2: 14 – 22 Rev. Ex.3 (p. 3.24) Level 1: 1 – 8 Level 2: 20 – 23			

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					Teaching Example 3.4 (Extra), Example 3.5, Teaching Example 3.5, Teaching Example 3.5 (Extra), Example 3.6, Teaching Example 3.6 **5-Minute Lecture:** The idea of C_r^n				
			3.2 Pascal's Triangle • Explore the pattern in the Pascal's triangle. • Understand how to use the Pascal's triangle to find the expansion of $(a + b)^n$, where	1	Example 3.7, Teaching Example 3.7, Example 3.8, Teaching Example 3.8 **Exploration:** 3.1	Exercise 3B (p. 3.12) Level 1: 1 – 8 Level 2: 9 – 15			

School Term	Weeks	Topics	Learning Objectives/ Teaching Focus	SL/AL	Teaching and Learning Activities	Consolidation and Assessment	Self-directed Learning Skills◆	Values#	Basic Law Education
			n is a non-negative integer.						
			3.3 The Binomial Theorem • Prove the binomial theorem. • Apply the binomial theorem to find the expansion of $(a + b)^n$, where n is a non-negative integer. • Find the coefficients of terms in binomial expansions. The following contents are **not** required: ◆ expansion of trinomials ◆ the greatest coefficient, the greatest term and the properties of binomial coefficients applications to numerical approximation	2	Example 3.9, Teaching Example 3.9, Example 3.10, Teaching Example 3.10, Teaching Example 3.10 (Extra), Example 3.11, Teaching Example 3.11, Example 3.12, Teaching Example 3.12, Example 3.13, Teaching Example 3.13 **Discussion:** 3.1 **5-Minute Lecture:**	Exercise 3C (p. 3.19) Level 1: 1 – 15 Level 2: 16 – 26 Rev. Ex. 3 (p. 3.24) Level 1: 9 – 19 Level 2: 24 – 35			

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					Coefficients of terms in binomial expansions **Animation:** Idea of Binomial Theorem				
	10-13	***Chapter 4 More about Trigonometric Functions (I)***	4.1 Radian Measure • Learn the concept of radian measure. • Learn the conversion between degrees and radians. • Learn to find arc lengths and areas of sectors using radian measure. • Students should understand that the relationship between the degree measure and the radian measure is given by π	2	Example 4.1, Teaching Example 4.1, Example 4.2, Teaching Example 4.2, Example 4.3, Teaching Example 4.3, Example 4.4, Teaching Example 4.4, Example 4.5, Teaching Example 4.5 **5-Minute Lecture:**	Exercise 4A (p. 4.10) Level 1: 1 – 12 Level 2: 13 – 18 Rev. Ex. 4 (p. 4.41) Level 1: 1 – 4 Level 2: 23 – 24, 35 – 36			

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			rad = 180°. • Students should know how to apply the formulas $s = r\theta$ and $A = \frac{1}{2}r^2\theta$, where θ is in radian measure.		Radian Measure				
			4.2 Trigonometric Functions • Recognise the definitions of the six trigonometric functions of angles of any magnitude. • Understand the trigonometric relations. • Learn the concept of a periodic function. • Recognise the graphs of the six trigonometric functions and their characteristics. • Students should know how to apply the trigonometric	4	Example 4.6, Teaching Example 4.6, Example 4.7, Teaching Example 4.7, Example 4.8, Teaching Example 4.8, Example 4.9, Teaching Example 4.9, Example 4.10, Teaching Example 4.10, Example 4.11, Teaching	Exercise 4B (p. 4.30) Level 1: 1 – 23 Level 2: 24 – 39 Rev. Ex. 4 (p. 4.41) Level 1: 5 – 16 Level 2: 25 – 27			

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			relations when they simplify trigonometric expressions. • Teachers should discuss the period, the maximum value, the minimum value and the range from the graph of each of trigonometric functions.		Example 4.11, Example 4.12, Teaching Example 4.12, Example 4.13, Teaching Example 4.13, Example 4.14, Teaching Example 4.14, Example 4.15, Teaching Example 4.15 **5-Minute Lecture:** Definitions of Trigonometric Functions **5-Minute Lecture:** Trigonometric Relations **5-Minute Lecture:**				

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					Trigonometric Graphs				
			4.3 Solving Simple Trigonometric Equations Learn different techniques to solve trigonometric equations for solutions in the interval from 0 to 2π. • Students should know how to apply the trigonometric relations when they solve trigonometric equations. • Students should pay attention to the interval of the solutions when they solve equations like sin $nx = k$, where $n \neq 1$.	2	Example 4.16, Teaching Example 4.16, Example 4.17, Teaching Example 4.17, Example 4.18, Teaching Example 4.18	Exercise 4C (p. 4.37) Level 1: 1 – 10 Level 2: 11 – 19 Rev. Ex. 4 (p. 4.41) Level 1: 17 – 22 Level 2: 28 – 34			
Second Term (31/12/2017-18/7/2018, Weeks 18-46)	18-21	***Chapter 5 More about Trigonometric Functions (II)***	5.1 Compound Angle Formulas • Learn and prove the compound angle formulas of sine, cosine and tangent	3	Example 5.1, Teaching Example 5.1, Example 5.2, Teaching Example 5.2,	Exercise 5A (p. 5.12) Level 1: 1 – 19 Level 2: 20 – 29 Rev. Ex. 5 (p. 5.34)			

School Term	Weeks	Topics	Learning Objectives/ Teaching Focus	SL/AL	Teaching and Learning Activities	Consolidation and Assessment	Self-directed Learning Skills◆	Values#	Basic Law Education
			functions. • Apply the compound angle formulas to solve trigonometric problems. • Students should understand the proofs of compound angle formulas.		Example 5.3, Teaching Example 5.3, Example 5.4, Teaching Example 5.4, Teaching Example 5.4 (Extra), Example 5.5, Teaching Example 5.5, Example 5.6, Teaching Example 5.6, Example 5.7, Teaching Example 5.7 **5-Minute Lecture:** Compound Angle Formulas	Level 1: 1, 3, 5 – 6, 8, 11 – 12 Level 2: 20, 22, 26 – 27			
			5.2	2	Example 5.8, Teaching	Exercise 5B (p. 5.20)			

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			Double Angle Formulas • Learn and prove the double angle formulas of sine, cosine and tangent functions. • Apply the double angle formulas to solve trigonometric problems. • Students should understand the proofs of double angle formulas.		Example 5.8, Example 5.9, Teaching Example 5.9, Example 5.10, Teaching Example 5.10, Example 5.11, Teaching Example 5.11 **Exploration:** 5.1 **5-Minute Lecture:** Double Angle Formulas	Level 1: 1 – 24 Level 2: 25 – 30 Rev. Ex. 5 (p. 5.34) Level 1: 2, 4, 7, 15, 17 Level 2: 19			
			5.3 Product to Sum and Sum to Product Formulas • Learn and prove the sum to product and product to sum formulas of sine and cosine functions. • Apply the product to sum	3.5	Example 5.12, Teaching Example 5.12, Example 5.13, Teaching Example 5.13, Example 5.14, Teaching	Exercise 5C (p. 5.30) Level 1: 1 – 14 Level 2: 15 – 22 Rev. Ex. 5 (p. 5.34) Level 1: 9 – 10, 13 – 14, 16			

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			and sum to product formulas of trigonometric functions to solve trigonometric problems. • Students should understand the proofs of product to sum and sum to product formulas.		Example 5.14, Example 5.15, Teaching Example 5.15, Example 5.16, Teaching Example 5.16 (Extra), Example 5.17, Teaching Example 5.17, Example 5.18, Teaching Example 5.18 **5-Minute Lecture:** Product to Sum and Sum to Product Formulas	Level 2: 18, 21, 23 – 25, 28 – 29			
	21-26	***Chapter 6 Introduction to Number e and Natural***	6.1 Introduction to Number *e* • Recognise the definition of	3	Example 6.1, Teaching Example 6.1, **Exploration:**	Exercise 6A (p. 6.8) Level 1: 1 – 6 Level 2: 7 – 9			

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		Logarithms	the number *e*. • Learn the characteristics of the graphs of $y = e^x$ and $y = e^{-x}$. • Recognise the exponential series $e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$ Teachers should illustrate the concept of a limit by some simple examples, e.g. the value of $\frac{1}{n}$, where *n* tends to positive infinity.		6.1 **5-Minute Lecture:** The Number *e* **Teaching Tools:** The Limiting Value of $\left(1+\frac{1}{n}\right)^n$ **5-Minute Lecture:** Exponential Functio*n*s and Series	Rev. Ex. 6 (p. 6.17) Level 1: 4 – 5			
			6.2 Natural Logarithms • Understand the definition of the natural logarithm. • Apply the properties of natural logarithm to simplify logarithmic expressions. • Learn the characteristics of	2	Example 6.2, Teaching Example 6.2, Example 6.3, Teaching Example 6.3, Example 6.4, Teaching Example 6.4,	Exercise 6B (p. 6.13) Level 1: 1 – 13 Level 2: 14 – 26 Rev. Ex. 6 (p. 6.17) Level 1: 1 – 3, 6 – 10 Level 2: 11 – 15			

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			the graph of $y = \ln x$. • Learn how to solve equations involving e and natural logarithms. Teachers may remind students of the logarithmic function which is discussed in Compulsory part book 4A chapter 5.		Example 6.5, Teaching Example 6.5, Example 6.6, Teaching Example 6.6, Example 6.7, Teaching Example 6.7 **5-Minute Lecture:** Natural Logarithms				
	27-34	***Chapter 7 Limits and Derivatives***	7.1 Functions • Understand the concept of functions. • Understand the concept of composite functions. Concepts of functions, domains, co-domains, dependent variables and	1	Example 7.1, Teaching Example 7.1 **5-Minute Lecture:** Composite Functions	Exercise 7A (p. 7.5) Level 1: 1 – 8 Level 2: 9 – 15 Rev. Ex.7 (p. 7.46) Level 1: 1 – 6 Level 2: 32, 33			

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			independent variables are taught in the Compulsory Part Book 4A Chapter 3.						
			7.2 Limits of Functions • Understand the intuitive concept of the limit of a function. • Understand the concepts of continuous functions and discontinuous functions. • Learn how to distinguish 'continuous functions' and 'discontinuous functions' from their graphs. • Recognise some common continuous functions and discontinuous functions. • Learn how to evaluate limits of continuous functions. • Understand and apply	3	Example 7.2, Teaching Example 7.2, Example 7.3, Teaching Example 7.3, Example 7.4, Teaching Example 7.4, Example 7.5, Teaching Example 7.5, Teaching Example 7.5 (Extra), Example 7.6, Teaching Example 7.6, Example 7.7, Teaching	Exercise 7B (p. 7.17) Level 1: 1 – 30 Level 2: 31 – 50 Rev. Ex.7 (p. 7.46) Level 1: 7 – 17 Level 2: 34 – 39			

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			theorems relating to limits of functions. • The proof of the existence of a limit is beyond the scope of the curriculum. • The formal proof of continuity of functions is not needed.		Example 7.7 **5-Minute Lecture:** Concept of Limits **5-Minute Lecture:** Continuous Functions				
			7.3 Limits at Infinity • Understand the concept of limits at infinity. • Learn how to evaluate limits of functions at infinity. • Recognise infinity as a limit. Students should understand the concepts of left-handed limit and right-handed limit. In Chapter 10, students must use such concepts to find	1.5	Example 7.8, Teaching Example 7.8, Example 7.9, Teaching Example 7.9, Teaching Example 7.9 (Extra), Example 7.10, Teaching Example 7.10 **5-Minute Lecture:** Limits at	Exercise 7C (p. 7.25) Level 1: 1 – 18 Level 2: 19 – 32 Rev. Ex.7 (p. 7.46) Level 1: 18, 19, 26, 27			

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			asymptotes of a curve.		Infinity **5-Minute Lecture:** Infinity as a Limit				
			7.4 Limits of Trigonometric Functions • Learn how to evaluate the limits of basic trigonometric functions. • Learn and apply the formula $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1$. Help students revise trigonometric identities which are useful to find limits involving trigonometric functions.	2	Example 7.11, Teaching Example 7.11, Example 7.12, Teaching Example 7.12, Example 7.13, Teaching Example 7.13, Example 7.14, Teaching Example 7.14 **Exploration:** 7.1	Exercise 7D (p. 7.33) Level 1: 1 – 15 Level 2: 16 – 24 Rev. Ex.7 (p. 7.46) Level 1: 20 – 22 Level 2: 40 – 42			
			7.5 The Limit $\lim_{x\to 0}\frac{e^x-1}{x}$	1	Example 7.15, Teaching Example 7.15	Exercise 7E (p. 7.36) Level 1: 1 – 9			

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			• Learn the theorem $\lim_{x\to 0}\frac{e^x-1}{x}=1$. • Apply $\lim_{x\to 0}\frac{e^x-1}{x}=1$ to evaluate limits. Make sure that students have already understood the concept of the number *e* in Chapter 6.			Level 2: 10 – 16 Rev. Ex.7 (p. 7.46) Level 1: 23 – 25 Level 2: 43 – 45			
			7.6 Derivatives • Understand the meanings of the tangent to a curve and the slope of a curve. • Find the slope of the tangent to a curve at a given point. • Understand the definition of derivatives of functions. • Understand the geometric meaning of derivatives of functions.	3	Example 7.16, Teaching Example 7.16, Example 7.17, Teaching Example 7.17, Example 7.18, Teaching Example 7.18 **5-Minute Lecture:** Concept of Derivatives	Exercise 7F (p. 7.42) Level 1: 1 – 15 Level 2: 16 – 24 Rev. Ex. 7 (p. 7.46) Level 1: 28 – 31 Level 2: 46, 47			

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			• Recognise the notations for the derivative of a function. • Find the derivatives of elementary functions from first principles. Finding derivatives of trigonometric functions, exponential functions and logarithmic functions from first principles are discussed in Chapter 9.		**Teaching Tool:** Tangent to a curve at a point				
	35-39	***Chapter 8 Differentiation (I)***	8.1 Basic Rules of Differentiation • Learn theorems to differentiate power functions, sum and difference of functions. • Understand product rule and quotient rule. Teachers may show the proofs of the basic rules	4	Example 8.1, Teaching Example 8.1, Example 8.2, Teaching Example 8.2, Example 8.3, Teaching Example 8.3, Example 8.4, Teaching Example 8.4,	Exercise 8A (p. 8.8) Level 1: 1 – 22 Level 2: 23 – 41 Rev. Ex. 8 (p. 8.31) Level 1: 1 – 6, 14 Level 2: 23, 36 Exercise 8B (p. 8.14) Level 1: 1 – 22			

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			using first principles.		Example 8.5, Teaching Example 8.5, Teaching Example 8.5 (Extra), Example 8.6, Teaching Example 8.6, Example 8.7, Teaching Example 8.7 **Discussion:** 8.1 **5-Minute Lecture:** Basic Rules of Differentiation	Level 2: 23 – 39 Rev. Ex. 8 (p. 8.31) Level 1: 7 – 9 Level 2: 28			
			8.2 Differentiation of Composite Functions • Recognise the concept of composite function.	3	Example 8.8, Teaching Example 8.8, Example 8.9, Teaching Example 8.9,	Exercise 8C (p. 8.20) Level 1: 1 – 18 Level 2: 19 – 35 Rev. Ex. 8 (p. 8.31)			

School Term	Weeks	Topics	Learning Objectives/ Teaching Focus	SL/AL	Teaching and Learning Activities	Consolidation and Assessment	Self-directed Learning Skills◆	Values#	Basic Law Education
			• Understand the chain rule. Teachers may show the proof of the chain rule, given in the appendix.		Example 8.10, Teaching Example 8.10, Example 8.11, Teaching Example 8.11 **5-Minute Lecture:** Differentiation of Composite Functions	Level 1: 10 – 13, 15 Level 2: 24 – 27, 29, 35, 38			
			8.3 Differentiation of Inverse Functions and Implicit Functions • Recognise the concept of inverse function. • Understand the inverse function rule. • Recognise the concept of implicit function. • Understand implicit differentiation. Teachers may prove the	4	Example 8.12, Teaching Example 8.12, Example 8.13, Teaching Example 8.13, Example 8.14, Teaching Example 8.14, Example 8.15, Teaching Example 8.15, Teaching	Exercise 8D (p. 8.24) Level 1: 1 – 10 Level 2: 11 – 16 Rev. Ex. 8 (p. 8.31) Level 1: 16, 17 Level 2: 30, 31, 37 Exercise 8E (p. 8.28) Level 1: 1 – 10			

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			inverse function rule by the chain rule.		Example 8.15 (Extra), Example 8.16, Teaching Example 8.16 **5-Minute Lecture:** Differentiation of Inverse Functions **5-Minute Lecture:** Implicit Differentiation	Level 2: 11 – 22 Rev. Ex. 8 (p. 8.31) Level 1: 18 – 22 Level 2: 32 – 34, 39 – 41			

Core Values of Wah Yan College, Kowloon

I. Love and care	1. Accept & feel positive about himself 2. Appreciation & Gratitude 3. Empathy & Compassion	4. Forgiveness & Reconciliation 5. Service 6. Family as a basic unit of society; marriage is the foundation of a family
II. Strive for excellence	7. Reflective 8. Commitment 9. Perseverance	10. Curiosity & willingness to learn 11. Value imagination and creativity

III. Respect and Justice	12. Life is valuable and respectable 13. Openness to good in all things 14. Respect for himself & others	15. Integrity 16. Faithfulness
IV. Responsibility	17. Freedom & Self-discipline 18. Care for the environment	19. Social Identities: citizen identity, national identity and global citizen identity
V. Faith	20. Experience of God 21. Explore & practise one's faith	22. Appreciate religious liturgies