» Mathematics Program Summary | **Prelim 2-Unit Course**

» TOPIC 1: **ALGEBRA**	
Simplify expressions	
Substitute into: expressions	
formulae	
Factorise: common factors	
difference of squares	
difference & sum of cubes	
trinomials	
by grouping pairs (4 terms)	
Simplify algebraic expressions	
Solve linear equations	
Solve linear inequalities	
Solve quadratic equations (3 methods)	
Solve simultaneous equations	
Surds: simplify	
add and subtract	
multiply	
rationalise denominators	
Indices: state index laws (4)	
simplify expressions	
explain negative indices	
simplify negative indices	
explain fractional indices	
convert surds ↔ indices	
Simplify: using index laws	
negative indices	
fractional indices	
Solve indicial equations	
Solve simultaneous indicial equations	

» TOPIC 2: **ABSOLUTE VALUE**	
Give fourfold definition	
Evaluate expressions	
Simplify algebraic expressions	
Graph simple functions	
Solve equations	
Solve inequalities	

» TOPIC 3: **CO-ORDINATE GEOMETRY**	
For a straight line, find:	
› Slope of line	
› Intercepts	
› Draw graph	
› Condition for point to be on line	
› Distance between two points	
› Midpoint of interval	
› General form equation	
› Point-gradient form equation	
› Angle of inclination (elevation)	
For parallel & perpendicular lines:	
› Given equation, find gradient	
› Find the value of k that makes lines parallel (or perpendicular)	
› Find equation of line through a point parallel/perpendicular to a line	
› Prove that $m_1 \times m_2 = -1$ for perpendicular lines	
› Prove that a figure is a rectangle	
› k-method for finding equation of a line concurrent with two other lines	
Find perpendicular distance between a point and a line	
Find equation of a circle from its locus definition (note: language)	
Write down equation of circle given its centre and radius	
Find centre and radius of circle given equation (central/general form)	
Test if line is tangent or chord to circle by:	
› solving simultaneous equations	
› using perpendicular distance formula	

» TOPIC 4: **TRIGONOMETRY**	
Re-define trigonometric ratios in terms of unit circle	
Evaluate trig ratios for angles in all quadrants (ASTC / graphical)	
Write exact values for all trig ratios of 0°, 30°, 45°, 60°, 90°, 180°, 270° and 360°.	
Sketch graphs of sin, cos & tan	
Solve simple trig equations	
Solve problems involving:	
› No diagram given	
› Angles of elevation & depression	
› Simple bearings	
› Triangles with common sides	
Use the sine rule	
Use the cosine rule	

» TOPIC 5: **GEOMETRY PROOFS**	
Define triangles & special quadrilaterals (see year 8 program)	
Define properties of angles on a straight line, vertically opposite angles, angles at a point; use properties in problems	
Identify parallel lines by testing angles	
Identify & calculate:	
› Exterior angles of triangle	
› Angle sum of triangle	
› External angles of general polygons	
› Angle sum of general polygons	
Test for congruent triangles	
Recognise properties of quadrilaterals	
Use sufficiency conditions to test for special quadrilaterals	
Test for similar triangles	
Calculate sides in similar triangles	
State & use Pythagoras' Theorem (and its converse)	
Derive & use formulae for quadrilaterals	
Prove the properties	
› Line parallel to one side of a triangle divides the other two sides in the same proportion	
› Line joining the midpoints of two sides of a triangle is parallel to the third side and half its length	
› Parallel lines preserve ratios of intercepts on transversals	
Complete simple numerical exercises of a deductive nature on these properties	
Solve problems with/without diagrams involving the properties above	

» TOPIC 6: **GRAPHS**	
Graph straight lines using intercepts (recognise intercept form of equation)	
Graph parabolas using axis of symmetry / vertex approach (plus intercepts)	
Graph circles & semi-circles	
Graph polynomial functions (e.g. cubics)	
Graph hyperbolae	

» TOPICS 7: **FURTHER GRAPHS & LOCUS**	
Understand the concept of a function	
Interpret function notation	
State domain and range of functions	
Graph simple cases where the function rule varies for different parts of the domain or the domain is restricted	
Define odd & even functions	
Identify and use symmetry properties of odd & even functions	
Locus: determine the set of points that satisfy a given set of conditions (either algebraically or geometrically)	
Graph inequalities including one non-linear factor	
Sketch graphs by addition of ordinates	

» TOPIC 8: **LIMITS & CALCULUS**	
Develop the notion of a gradient function and predict one given tabulated values	
* Develop the informal idea of a limit	
* Define continuity	
* Define differentiability	
State the formal definition of a derivative (i.e. first principles)	
Using first principles, find derivatives of:	
› Quadratic & cubic expressions	
› x^n for positive integer n	
› $y = \sqrt{x}$ and $y = 1/x$	
Prove (from definition) the derivatives for $c \times f(x)$ and $f(x) \pm g(x)$	
Complete simple exercises	
Use correct notation	
Find equations of tangent and normal	

» TOPIC 9: **PRODUCTS, QUOTIENTS, FUNCTION of a FUNCTION**	
Prove product rule	
Understand the concept of a function of a function	
Derive the chain rule	
Complete exercises with chain rule	
Prove the quotient rule	
Use these rules to find equations of tangents and normals	

» TOPIC 10: **QUADRATICS**	
Solve quadratic equations (3 methods)	
Find roots using quadratic formula	
Solve quadratic inequalities using an appropriate graph	
Establish the relation between roots and co-efficients	
Find the discriminant and use it to determine types of roots	
Identify types of quadratic expressions	
Write identical quadratic expressions (quadratic identities)	
Solve equations reducible to quadratics	

» TOPIC 11: **RADIAN MEASURE**	
Define a radian and convert w/ degrees	
Evaluate expressions with radians	
Find the length of an arc	
Find the area of a sector	
Find the area of a segment	
Apply formulae to problems	
Graph trig functions in radians	
Solve simple equations using graphs	

» TOPIC 12: **TRIG IDENTITIES & EQNS**	
Write down basic identities	
Complete simple proofs of identities	
Solve simple linear equations	

» TOPIC 13: **LOG & EXP FUNCTIONS**	
Find values of $2^x, 3^x, 4^x$ ...	
Draw graphs of $y = 2^x, 3^x, 4^x$ ...	
Graph $y = e^x$	
Define $\log_a x$ and $\log_e x$	
Evaluate simple logarithmic expressions	
Sketch logarithmic graphs	
Use index laws to prove log rules	
Simplify numerical expressions	
Solve simple equations in both logarithmic form and index form	
Simplify algebraic expressions	

» TOPIC 14: **CALCULUS OF TRIG, EXPONENTIALS & LOGARITHMS**	
* Prove $\sin x < x < \tan x$ for $0 < x < \pi/2$	
* Prove that for small values of x, $\sin x \approx x \approx \tan x$	
* Deduce results for $\lim_{x\to 0} \frac{\sin x}{x}$ and $\lim_{x\to 0} \frac{\tan x}{x}$	
Prove derivative of trig functions and their reciprocals	
Find simple derivatives of expressions containing trig functions	
Complete exercises using the product, quotient and chain rules involving trigonometric expressions	
Find the equation of tangents and normals to curves	
Find derivative of $y = a^x$ for some constant a	
Find derivative of $y = e^x$ and $y = e^{f(x)}$	
Investigate the relation $\frac{dy}{dx} \times \frac{dx}{dy} = 1$	
Find derivative of $\ln x$ and $\ln f(x)$	
Find derivatives of simple expressions containing log functions	
Solve simple problems involving differentiation of log expressions	

» TOPIC 15: **APPS OF DIFFERENTIATION**	
State significance of the sign of the first derivative	
Define and identify monotonic increasing and decreasing functions	
Find stationary points on a curve	
Identify local maxima/minima	
Distinguish between local/absolute maxima/minima over a given domain	
Define the second derivative	
Find second derivative and use it to determine concavity	
Investigate geometrical significance of the sign of the second derivative	
Examine inflexional tangents	
Find points of inflexion and horizontal points of inflexion	
Sketch simple polynomial curves and rational functions using calculus techniques to identify features	
Sketch a portion of a curve given properties of y' and y''	
Sketch y' & y'' given a graph of $y = f(x)$	
Max/min value problems: construct a function based on data given in words or a diagram	
Consider restrictions on variables	

» TOPIC 16: **LOCUS & THE PARABOLA**	
Find perpendicular distance from a point to a line	
Define parabola in locus terminology	
Use locus definition to obtain equation of a parabola	
Sletch a parabola where equation is given in locus-centric form	
Write down equation of a parabola given two of the following: focus, vertex or directrix	
Sketch parabolas showing intercepts, axis of symmetry and vertex	
Complete the square to find vertex, focus and directrix from equation of parabola in general form	
Solve inequalities involving quadratics	

While the exam cut-offs vary from year to year, in general:

- The **first 9 topics** are assessed in the Term 2 Half-Yearly exam (i.e. up to and including rules of differentiation)
- **All topics** are assessed in the Term 3 Preliminary Final exam

Items with an asterisk (*) next to them are not examinable. Use this program summary together with the full program in order to make sure you understand all the prescribed knowledge and skills.