### Mathematics Program Summary | HSC 2-Unit Course

#### TOPIC 1: RADIAN MEASURE & TRIGONOMETRIC FUNCTIONS
- Define an angle of one radian
- Convert between degrees & radians
- 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 actual problems
- Establish that limit of \( \sin x / x \) as \( x \to 0 = 1 \)
- Graph trigonometric functions
- Determine period & amplitude
- Determine domain and range
- Graph extended trigonometric graphs, e.g. \( y = a \sin(bx + c) \)

#### TOPIC 2: DIFFERENTIATION RULES
- Expressions requiring simplification
- Expressions containing trigonometric, exponential and logarithmic terms
- Use product and quotient rule
- Use chain rule
- Find equation of tangent or normal

#### TOPIC 3: PROOFS W/ CO-ORD. GEOM.
- Find gradient, midpoint and distance
- Write down equation of a line given certain features of the line
- Solve geometric problems

#### TOPIC 4: CURVE SKETCHING WITH CALCULUS
- Explain significance of sign of derivative
- Find domain in which a function is increasing or decreasing
- Find stationary points
- Test for local maxima/minima
- Distinguish between local maxima/minima and maxima/minima in a given domain
- Explain geometrical significance of second derivative
- Test for concavity
- Test for points of inflexion and horizontal points of inflexion
- Find equation of inflexional tangent
- Sketch curves with above techniques
- Sketch \( y = f(x) \) based on properties of \( y' \) & \( y'' \)
- Sketch \( y' \) & \( y'' \) based on \( y = f(x) \)

#### TOPIC 5: TRIANGLE TRIGONOMETRY
- Solve problems with right-angled \( \Delta \)
- State and use Sine Rule
- State and use Cosine Rule
- Solve problems with \( \Delta \)s that have common sides

#### TOPIC 6: MAX/MIN VALUE PROBLEMS
- Find stationary values for geometrical and practical situations
- Construct function based on data given in diagram or words
- Recognise both endpoints and stationary points as possible solutions

#### TOPIC 7: SEQUENCES & SERIES
- Extend and generalise given number patterns / sequences

#### Arithmetic sequences:
- **Define**
  - Find general term \( T_n \)
  - Find sum of \( n \) terms
  - Determine if number belongs to an arithmetic series

#### Geometric sequences:
- **Define**
- Find general term \( T_n \)
- Find sum of \( n \) terms
- Find limiting sum
- Determine if number belongs to a geometric series
- Given a general term \( T_n \), prove that it forms a geometric series
- Given \( S_n \), find expression for \( T_n \)

#### TOPIC 8: PRIMITIVES & INTEGRATION
- Recognise standard forms
- Integrate expressions with sums & differences
- Integrate functions that require initial algebraic simplification
- Choose appropriate methods for integration
- Use link between differentiation and integration to evaluate an integral
- Find \( f(x) \) given \( f'(x) \) and a point that is on the curve

#### TOPIC 9: AREAS UNDER CURVES
- Perform calculations involving:
  - Areas for curves above \( x \)-axis
  - Areas for curves that cut \( x \)-axis
  - Areas bounded by 2 curves
  - Areas involving addition and subtraction of integrals
  - Areas involving the \( y \)-axis
  - Simpson’s Rule
  - Trapezoidal Rule
- Distinguish between integral & area

#### TOPIC 10: VOLUMES
- Find the volume of solids rotated around both \( x \)-axis and \( y \)-axis
- Derive volume of cone & sphere
- Use Simpson’s rule to find approximation of volume
- Find volumes involving trig. graphs and ones leading to logarithmic and exponential functions

#### TOPIC 11 & 20: GEOMETRY PROOFS
- Year 7-11 knowledge & skills

#### TOPIC 12: GRAPHS
- Graph equalities & inequalities with straight lines
- Graph circles
- Recognise and graph semi-circles
- Graph parabolas
- Graph hyperbolas
- Graph regions involving unions and intersections of inequalities

#### TOPIC 13: GROWTH & DECAY
- Graph \( y = Ae^{kt} \)
- Convert verbal information to a differential equation
- Prove by substitution that \( y = Ae^{kt} \) is a solution of \( dy/dt = k \cdot y \)
- Solve problems with given features

#### TOPIC 14: MOTION (Differentiation)
- Describe motion verbally given displacement as a function of time
- Describe motion verbally given velocity as a function of time
- Describe motion verbally given acceleration as a function of time

#### TOPIC 15: PROBABILITY
- Use dot diagrams to represent sample space for 2-stage events
- Distinguish between situations that require addition or product rule
- Use tree diagrams to represent multiple-stage events
- Use probability tree diagrams to represent multiple-stage events with varying chances
- Solve problems with:
  - mutually exclusive events
  - complementary events

#### TOPIC 16: MOTION (Integration)
- Understand that two-dimensional graph represents one-dimensional movement and time, not two-dimensional motion
- Find expressions for:
  - Displacement, given velocity
  - Velocity, given displacement
  - Displacement & velocity, given acceleration

#### TOPIC 17: QUADRATICS
- Solve quadratic equations
- Solve quadratic inequalities
- Write down relation between roots and co-efficients
- Define discriminant
- Use discriminant to identify different types of roots
- Find condition that gives real, unequal / distinct or unreal roots
- Find condition for other quadratic to be positive or negative definite

#### TOPIC 18: LOCUS & PARABOLA
- Derive equation of parabola given focus and directrix
- Find vertex, focus and directrix given equation of a parabola
- Find points of intersection of parabolas

#### TOPIC 19: RATES OF CHANGE
- Apply understanding of integration to physical situations
- Solve problems in which a derivative statement is given

#### TOPIC 20: ABSOLUTE VALUE
- Draw absolute value graphs
- Solve:
  - Equations involving absolute values
  - Inequalities involving absolute values

For more details, please see the full mathematics program, available for download on the school intranet.