# Erindale College

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| **Assessment Period:** | **2022 S1** |
| **Course:** | **SPECIALIST MATHEMATICS** |
| **Unit:** | **Unit 1: Specialist Mathematics (1.0)** |
| **Accreditation:** | **T** |
| **Year:** | **11** |

## Specific Unit Goals

This unit should enable students to:

- understand the concepts and techniques in combinatorics, geometry and vectors
- apply reasoning skills and solve problems in combinatorics, geometry and vectors
- communicate their arguments and strategies when solving problems
- construct proofs in a variety of contexts including algebraic and geometric
- interpret mathematical information and ascertain the reasonableness of their solutions to problems

## Content Descriptions

### Topic 1: Combinatorics

- permutations (ordered arrangements):
    - solve problems involving permutations
    - use the multiplication principle
    - use factorial notation
    - solve problems involving permutations and restrictions with or without repeated objects
- the inclusion-exclusion principle for the union of two sets and three sets:
    - determine and use the formulas for finding the number of elements in the union of two and the union of three sets
- the pigeon-hole principle:
    - solve problems and prove results using the pigeon-hole principle
- Combinations (unordered selections):
    - solve problems involving combinations
    - use the notation $\binom{n}{r}$ or ${}^{n}C_{r}$
    - derive and use simple identities associated with Pascal's triangle

### Topic 2: Vectors in the plane

- Representing vectors in the plane by directed line segments:
    - examine examples of vectors including displacement and velocity
    - define and use the magnitude and direction of a vector
    - represent a scalar multiple of a vector
    - use the triangle rule to find the sum and difference of two vectors
- Algebra of vectors in the plane:
    - use ordered pair notation and column vector notation to represent a vector

- define and use unit vectors and the perpendicular unit vectors i and j
- express a vector in component form using the unit vectors i and j
- examine and use addition and subtraction of vectors in component form
- define and use multiplication by a scalar of a vector in component form
- define and use scalar (dot) product
- apply the scalar product to vectors expressed in component form
- examine properties of parallel and perpendicular vectors and determine if two vectors are parallel or perpendicular
- define and use projections of vectors
- solve problems involving displacement, force and velocity involving the above concepts

## Topic 3: Geometry

- The nature of proof:
  - use implication, converse, equivalence, negation, contrapositive
  - use proof by contradiction
  - use the symbols for implication $\left(\Longrightarrow\right)$, equivalence $\left(\Longleftrightarrow\right)$, and equality$\left(=\right)$
  - use the quantifiers 'for all' and 'there exists'
  - use examples and counter-examples

- Circle properties and their proofs including the following theorems:
  - an angle in a semicircle is a right angle
  - the angle at the centre subtended by an arc of a circle is twice the angle at the circumference subtended by the same arc
  - angles at the circumference of a circle subtended by the same arc are equal
  - the opposite angles of a cyclic quadrilateral are supplementary
  - chords of equal length subtend equal angles at the centre and conversely chords subtending equal angles at the centre of a circle have the same length
  - the alternate segment theorem
  - when two chords of a circle intersect, the product of the lengths of the intervals on one chord equals the product of the lengths of the intervals on the other chord
  - when a secant (meeting the circle at A and B) and a tangent (meeting the circle at T) are drawn to a circle from an external point M, the square of the length of the tangent equals the product of the lengths to the circle on the secant ($\mathrm{AM} \times \mathrm{BM} = \mathrm{TM}^2$)
  - suitable converses of some of the above results
  - solve problems finding unknown angles and lengths and prove further results using the results listed above

- Geometric proofs using vectors in the plane including:
  - the diagonals of a parallelogram meet at right angles if and only if it is a rhombus
  - midpoints of the sides of a quadrilateral join to form a parallelogram
  - the sum of the squares of the lengths of the diagonals of a parallelogram is equal to the sum of the squares of the lengths of the sides

## Assessment Tasks

| Name | Due Date | Weighting |
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| Assignment | 18 March | 30% |
| Exam 1 | 29 March - 1 April | 35% |
| Exam 2 | 14 June - 17 June | 35% |

## Specific Unit Information

Students require a graphics calculator for this course. These are available for hire at a cost of $100 per year, consisting of a $50 hire fee and a $50 refundable deposit. Students may choose to purchase or provide their own calculator.

## School Assessment Information

### For penalties for late and non-submission of work

See BSSS Policy and Procedure Manual 4.3.10 for further information.

### For academic integrity

See BSSS Policy and Procedure Manual 4.3.12 for further information.

### For appeals processes

See BSSS Policy and Procedure Manual 7.2 for further information.

### For moderation procedures (internal and external)

See BSSS Policy and Procedure Manual 5 for further information.

### For meshing procedures

See BSSS Policy and Procedure Manual 5.4.1 for further information.

### For method of unit score calculation

See BSSS Policy and Procedure Manual 4.3.6.2 for further information.

### For procedures for calculating course scores

See BSSS Policy and Procedure Manual 4.3.13.2 for further information.

## Achievement Standards for SPECIALIST MATHEMATICS T - Year 11

| | *A student who achieves an **A** grade typically* | *A student who achieves a **B** grade typically* | *A student who achieves a **C** grade typically* | *A student who achieves a **D** grade typically* | *A student who achieves an **E** grade typically* |
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| **Concepts and Techniques** | • critically applies mathematical concepts in a variety of complex contexts to routine and non-routine problems<br>• selects and applies advanced mathematical techniques to solve complex problems in a variety of contexts<br>• constructs, selects and applies complex mathematical models to routine and non-routine problems in a variety of contexts<br>• uses digital technologies efficiently to solve routine and non-routine problems in a variety of contexts | • applies mathematical concepts in a variety of contexts to routine and non-routine problems<br>• selects and applies mathematical techniques to solve routine and non-routine problems in a variety of contexts<br>• selects and applies mathematical models to routine and non-routine problems to a variety of contexts<br>• uses digital technologies effectively to solve routine and non-routine problems in a variety of contexts | • applies mathematical concepts in some contexts to routine and non-routine problems<br>• applies mathematical techniques to solve routine and non-routine problems in some contexts<br>• applies mathematical models to routine and non-routine problems in some contexts<br>• uses digital technologies appropriately to solve routine and non-routine problems in some contexts | • applies simple mathematical concepts in limited contexts to routine problems<br>• applies simple mathematical techniques to solve routine problems in limited contexts<br>• applies simple mathematical models to routine problems in limited contexts<br>• uses digital technologies appropriately to solve routine problems in limited contexts | • applies simple mathematical concepts in structured contexts<br>• uses simple mathematical techniques to solve routine problems in structured contexts<br>• demonstrates limited familiarity with mathematical models in structured contexts<br>• uses digital technologies to solve routine problems in structured contexts |
| **Reasoning and Communications** | • represents complex mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems in a variety of contexts<br>• communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are succinct and well-reasoned, using appropriate and accurate language<br>• evaluates the reasonableness of solutions to routine and non-routine problems in a variety of contexts<br>• reflects with insight on their own thinking and that of others and evaluates planning, time management, use of appropriate strategies to work independently and collaboratively<br>• evaluates the potential of Mathematics to generate knowledge in the public good | • represents mathematical concepts in numerical, graphical and symbolic form in routine and non-routine problems a variety of contexts<br>• communicates mathematical judgements and arguments in oral, written and/or multimodal forms, which are clear and reasoned, using appropriate and accurate language<br>• analyses the reasonableness of solutions to routine and non-routine problems<br>• reflects on their own thinking and analyses planning, time management, use of appropriate strategies to work independently and collaboratively<br>• analyses the potential of Mathematics to generate knowledge in the public good | • represents mathematical concepts in numerical, graphical and symbolic form to some routine and some non-routine problems in some contexts<br>• communicates mathematical judgements and arguments in oral, written and/or multimodal forms, using appropriate and accurate language<br>• explains the reasonableness of solutions to some routine and non-routine problems<br>• reflects on their own thinking and explains planning, time management, use of appropriate strategies to work independently and collaboratively<br>• explains the potential of Mathematics to generate knowledge in the public good | • represents simple mathematical concepts in numerical, graphical or symbolic form in routine problems in limited contexts<br>• communicates simple mathematical judgements or arguments in oral, written and/or multimodal forms, with some use of appropriate language<br>• describes the appropriateness of solutions to routine problems<br>• reflects on their own thinking with some reference to planning, time management, use of appropriate strategies to work independently and collaboratively<br>• describes the potential of Mathematics to generate knowledge in the public good | • represents simple mathematical concepts in numerical, graphical or symbolic form in structured contexts<br>• communicates simple mathematical information in oral, written and/or multimodal forms, with limited use of appropriate language<br>• identifies solutions to routine problems in structured contexts<br>• reflects on their own thinking with little or no reference to planning, time management, use of appropriate strategies to work independently and collaboratively<br>• identifies some ways in which Mathematics is used to generate knowledge in the public good |