 Year 11 mathematics extension 1

| ME-F1.4 Parametric form of a function or relation | Unit duration |
| --- | --- |
| The topic Functions involves the use of both algebraic and graphical conventions and terminology to describe, interpret and model relationships of and between changing quantities. This topic provides the means to more fully understand the behaviour of functions, extending to include inequalities, absolute values and inverse functions. A knowledge of functions enables students to discover connections between algebraic and graphical representations, to determine solutions of equations and to model theoretical or real-life situations involving algebra. The study of functions is important in developing students’ ability to find, recognise and use connections, to communicate concisely and precisely, to use algebraic techniques and manipulations to describe and solve problems, and to predict future outcomes in areas such as finance, economics and weather. | 2 – 3 lessons |

| Subtopic focus | Outcomes |
| --- | --- |
| The principal focus of this subtopic is to further explore functions in a variety of contexts including: reciprocal and inverse functions, manipulating graphs of functions, and parametric representation of functions. The study of inequalities is an application of functions and enables students to express domains and ranges as inequalities. Students develop proficiency in methods to identify solutions to equations both algebraically and graphically. The study of inverse functions is important in higher Mathematics and the calculus of these is studied later in the course. The study of parameters sets foundations for later work on projectiles. | A student:* uses algebraic and graphical concepts in the modelling and solving of problems involving functions and their inverses ME11-1
* manipulates algebraic expressions and graphical functions to solve problems ME11-2
* uses appropriate technology to investigate, organise and interpret information to solve problems in a range of contexts ME11-6
* communicates making comprehensive use of mathematical language, notation, diagrams and graphs ME11-7
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| Prerequisite knowledge | Assessment strategies |
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| Students should have studied the concepts explored in MA-F1 and ME-F1.1-1.3. | * Students could work in pairs or small groups determine a variety of parametric pairs for a series of linear and quadratic Cartesian equations.
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All outcomes referred to in this unit come from [Mathematics Extension 1](http://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/stage-6-mathematics/mathematics-extension-1-2017) Syllabus
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Glossary of terms

| Term | Description |
| --- | --- |
| causation | Causation describes a cause and effect relationship between two quantities, where the relationship is linear. |
| correlation | Correlation describes a linear relationship between two variables which is not necessarily causal (see causation above). |
| parameter | A parameter is a quantity that defines certain characteristics of a function or system. For example $θ$ is a parameter in $y=x\cos(θ)$A parameter can be a characteristic value of a situation. For example the time taken for a machine to produce a certain product. |

Lesson sequence

| Lesson sequence | ContentStudents learn to: | Suggested teaching strategies and resources  | Date and initial | Comments, feedback, additional resources used |
| --- | --- | --- | --- | --- |
| Parametric and Cartesian form(2 lessons) | * understand the concept of parametric representation and examine lines, parabolas and circles expressed in parametric form
	+ understand that linear and quadratic functions, and circles can be expressed in either parametric form or Cartesian form
	+ convert linear and quadratic functions, and circles from parametric form to Cartesian form and vice versa
 | **Introduction to parameters*** Consider introducing the concept of parameters by illustrating a real-life scenario of parameters in action. The article, [A Quick Intuition for Parametric Equations](https://betterexplained.com/articles/a-quick-intuition-for-parametric-equations/) introduces the concept around sunscreen and ice cream sales at a convenience store. It states that while you could write an algebraic relationship between the two, it would be misleading to do so. The sales have a positive **correlation**, but it is not a **causal** relationship. There is actually a third variable, temperature, which changed the sales of both items. Teachers may use a similar approach to this analogy seen in the three part series Introduction to Parametrics [Part 1](https://www.youtube.com/watch?time_continue=1&v=zBYs6ppuMSk), [Part 2](https://www.youtube.com/watch?v=n0NvnT-bWZ8) and [Part 3](https://www.youtube.com/watch?v=hfSLWLduTWs). Consider a number of other examples where a third variable might cause two other variables to show a correlation relationship. For example – TVs and obesity

**Parametric and Cartesian equations*** Parametric equations are used to give two related variables expressions using a third variable called a parameter. For example
	+ Linear parametric equations: $$x=3p, y=p-1$$
	+ Quadratic parametric equations: $$x=2at, y=at^{2}$$
	+ Circles: $x=\cos(t), y=\sin(t)$

**Note:** Since parametric form for circles involve trigonometry, the identities can be introduced here for the purpose of the topic or taught when the trigonometric identities are introduced in Trigonometry * To write in Cartesian form, the third parameter must be eliminated to produce one equation relating, for example, $x $and $y$.
* When converting Cartesian form to parametric form, one parametric equation should be provided.
* Discuss how there are infinitely many pairs of parametric equations possible for one Cartesian equation, depending on the choice of coordinate pairs
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| Sketching from Parametric Form (1 lesson) | * understand the concept of parametric representation and examine lines, parabolas and circles expressed in parametric form
	+ sketch linear and quadratic functions, and circles expressed in parametric form
 | * Use the DESMOS resource [Parametric Equations](http://learn.desmos.com/parametric-equations/) to help graph parametric equations.
* Students to practise graphing from parametric equations, using [DESMOS](https://www.desmos.com/calculator) to check solutions.
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Reflection and evaluation

Please include feedback about the engagement of the students and the difficulty of the content included in this section. You may also refer to the sequencing of the lessons and the placement of the topic within the scope and sequence. All ICT, literacy, numeracy and group activities should be recorded in comments, feedback, additional resources used sections.