Full Name: _____

Mathematics Methods
YEAR 11
Investigation 2 – Features of Polynomials

Semester 1 2019

Time allowed: Four weeks
Latest submission date is 3.15pm Friday 3 May 2019

Email submission is acceptable if send to darren.jacques@education.wa.edu.au
(please expect acknowledgement of email submission)

Information: **The cover page at the end of this task sheet must be attached to the front of your report prior to submission. If submitting electronically, copy the cover page and paste it into your report as the first page.**

It is expected that this assessment task be completed outside of the classroom environment. Any teacher can be asked for advice with the exception of Mr Jacques, who will be evaluating your responses to this task.

It is expected that the report be your own work and unique when compared to the submitted work of other students in this course.

You will receive a grade from the attached Performance Standards and a numerical mark for this assessment.

This Investigation is taken from:
Stage 1 Mathematics

Task

A real polynomial function of degree 4 is a function of the form $p(x) = ax^4 + bx^3 + cx^2 + dx + e$ where a, b, c, d, and e are real numbers, $a \neq 0$.

Every real polynomial of degree 4 can be factorised into one of seven forms. In your investigation you will consider a number of the seven forms.

The aim of this project is to investigate the graphs of real polynomial functions of degree 4 with particular reference to:

- the number of turning points
- the number of inflection points.

Part A

1) Investigate, using an appropriate graphing package, at least ***three*** real polynomials with four distinct real linear factors of the form $p(x) = a(x-\alpha)(x-\beta)(x-\gamma)(x-\delta), a \neq 0$.

   Present the information and a small graph of each into a table. An example of the table you could use is presented below.

Function	Roots used	Number of turning points	Number of points of inflection	Graph

2) Investigate at least ***three*** real polynomials with five distinct real linear factors of the form $p(x) = a(x-\alpha)(x-\beta)(x-\gamma)(x-\delta)(x-\varepsilon), a \neq 0$. Present the information in a table as above.

3) Present a possible conjecture in regard to the number of turning points and points of inflection for a polynomial of degree, n, with n distinct real linear factors.

Conjecture: an opinion or conclusion formed on the basis of incomplete information.

4) Support your conjecture by investigating another polynomial with a degree of your choice.

Part B

1) Investigate at least ***three*** real polynomials with a squared real linear factor and two distinct real linear factors, $p(x) = a(x-\alpha)^2(x-\beta)(x-\gamma), a \neq 0$. Present the information in a table as above.

2) Extend this investigation to polynomials of degree five and beyond, with only one squared real linear factor, $p(x) = a(x-\alpha)^2(x-\beta)(x-\gamma)(x-\delta), a \neq 0$.

3) Present a possible conjecture in regard to the number of turning points and points of inflection for a polynomial of this form.

4) Support your conjecture by investigating another polynomial with a degree of your choice.

Part C

There are several other possible combinations of factors for a quartic polynomial. Continue your investigation into at least two of these other possibilities, **including a polynomial having a real quadratic factor with complex conjugate roots.**

Summarising the Task

You must write a report summarising your findings in this investigation.

The format of an investigation report may be written or multimodal.

The investigation report should be a **maximum of 10 pages** if written, or the equivalent in multimodal form.

Your report on the mathematical investigation should include the following:

- an outline of the problem and context
- the method required to find a solution, in terms of the mathematical model or strategy used
- the application of the mathematical model or strategy, including:
    - relevant data and/or information
    - mathematical calculations and results, using appropriate representations
    - the analysis and interpretation of results, including consideration of the reasonableness and limitations of the results
- the results and conclusions in the context of the problem
- a bibliography and appendices, as appropriate.

Performance Standards

	Concepts and Techniques	Reasoning and Communication
A	Comprehensive knowledge and understanding of concepts and relationships. Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations. Proficient and accurate use of appropriate mathematical notation, representations, and terminology. Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Formation and testing of appropriate predictions, using sound mathematical evidence.
B	Some depth of knowledge and understanding of concepts and relationships. Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts. Attempted development and successful application of mathematical models to find mostly accurate solutions. Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems.	Mostly appropriate interpretation of mathematical results in the context of the problem. Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations. Mostly accurate use of appropriate mathematical notation, representations, and terminology. Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments. Formation and testing of mostly appropriate predictions, using some mathematical evidence.
C	Generally competent knowledge and understanding of concepts and relationships. Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in different contexts. Application of mathematical models to find generally accurate solutions. Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems.	Generally appropriate interpretation of mathematical results in the context of the problem. Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations. Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy. Generally effective communication of mathematical ideas and reasoning to develop some logical arguments. Formation of an appropriate prediction and some attempt to test it using mathematical evidence.
D	Basic knowledge and some understanding of concepts and relationships. Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in context. Some application of mathematical models to find some accurate or partially accurate solutions. Some appropriate use of electronic technology to find some accurate solutions to routine problems.	Some interpretation of mathematical results. Drawing some conclusions from mathematical results, with some awareness of their reasonableness. Some appropriate use of mathematical notation, representations, and terminology, with some accuracy. Some communication of mathematical ideas, with attempted reasoning and/or arguments. Attempted formation of a prediction with limited attempt to test it using mathematical evidence.
E	Limited knowledge or understanding of concepts and relationships. Attempted selection and limited application of mathematical techniques or algorithms, with limited accuracy in solving routine problems. Attempted application of mathematical models, with limited accuracy. Attempted use of electronic technology, with limited accuracy in solving routine problems.	Limited interpretation of mathematical results. Limited understanding of the meaning of mathematical results, their reasonableness or limitations. Limited use of appropriate mathematical notation, representations, or terminology, with limited accuracy. Attempted communication of mathematical ideas, with limited reasoning. Limited attempt to form or test a prediction.

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Assessment Submission Form

Student Name	
Teacher	
Date Submitted	
Office use only **Date Received**	
Office use only **Grade/Mark**	

A SIGNED COPY OF THIS FORM MUST ACCOMPANY ALL SUBMISSIONS FOR ASSESSMENT.

STUDENTS SHOULD KEEP A COPY OF ALL WORK SUBMITTED.

Note: There are penalties for the late submission of assessments and for Plagiarism. For further information please see the Senior School Assessment Policy.

Plagiarism is the unacknowledged inclusion of another person's writings or ideas or works, in any formally presented work (including essays, examinations, projects, reports or presentations).

Declaration of Authorship

I declare that all material in this assessment is my own work except where there is clear acknowledgement and appropriate reference to the work of others.

Signed…… Date ……

Note: For electronic submission, a typed name instead of a signature is acceptable.