# Investigation: Product of Polynomials

**Overview of the task and breakdown of components**

* **Component 1**
  + Sketching cubic graphs of the form
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  + Sketching cubic graphs of the form
  + Recognising the connection between the values of and the -interepts
  + Recognising the connection between the degree of a factor and the behaviour of the cubic graph at the -intercept(s)
  + Summarising and generalising results/observations through comparison of examples or pattern recognition, and using mathematical notation and/or everyday language to describe generalisations
* **Component 2**
  + Sketching graphs of the form for given values of and
  + Recognising the connection between the degree of a factor and the behaviour of the polynomial graph at the -intercept(s)
  + Recognising the connection between the degree of the polynomial and the overall shape/behaviour of the graph
  + Summarising and generalising results/observations through comparison of examples or pattern recognition, and using mathematical notation and/or everyday language to describe generalisations
* **Component 3**
  + Sketching graphs of the form for given constraints   
    on and
  + Recognising the importance of fully factorising an expression to locate and identify the key features of a graph
  + Summarising and generalising results/observations through comparison of examples or pattern recognition, and using mathematical notation and/or everyday language to describe generalisations

**Possible ways to implement such a task**

* Would typically spend maybe half a week to one week on higher-order polynomial graphs.
* Could replace textbook work with such a task (Instead of Ch6-whatever from Cambridge or Ch5-whatever from Jacaranda).
* As part of the task, it would be advised for students to summarise/comment on what they are observing/finding (e.g. what is similar/different? What do you notice?) and what they have learnt/understood. There’s often a discrepancy between what we tell/teach students and what they understand (or interpret what we say).
* Such a task could be for formative assessment purposes, with no weighting assigned to the investigation. Its primary function is a learning instrument. There could be a summative assessment (test) for the entire cubics/polynomials topic that assesses ideas explored in the investigation.

**TI Video YouTube links (Sliders and maybe some useful commands)**

# Inserting and Using Sliders | TI-Nspire CX II | Getting Started Series - Graphs Application <https://www.youtube.com/watch?v=jHY6X5Er0Ew>

# Sliders in Notes | TI-Nspire CX II CAS | Getting Started Series - Notes Application

<https://www.youtube.com/watch?v=b4pt8R_0HzM>

For additional support: <https://education.ti.com/en-au/resources/getting-started-with-ti-technology/student-course-lessons-ti-nspire-cx-ii-cas>

**Component 1**

In this component you will consider graphs of cubic polynomials.

1. Consider the family of curves of the form where are real numbers .
2. i. By selecting your own values for where , sketch 3 cubic graphs of the above form. Label your axial intercepts with coordinates. Also write the equation for each corresponding graph.
3. Comment on any similarities/differences between your graphs.
4. Discuss how affect the key features of the graph.
5. What happens to the shape and key features of the cubic graph if ? Investigate. Provide 3 examples to support your ideas/conjectures. Label your axial intercepts with coordinates. Also write the equation for each corresponding graph.  
   Comment on any similarities/differences. Try to generalise your observations.
6. What happens to the shape and key features of the cubic graph if ? Investigate. Provide 3 examples to support your ideas/conjectures. Label your axial intercepts with coordinates. Also write the equation for each corresponding graph.  
   Comment on any similarities/differences. Try to generalise your observations.
7. Consider the family of curves of the form ,   
   where are non-zero real numbers.  
   Investigate how affect the shape and key features of the graph.  
   Provide examples to support your ideas/conjectures. Summarise/describe your observations, and try to generalise your observations.

**Component 2**

In this component you will consider graphs of the form , where is non-zero real number and

1. Consider the case where .
2. Sketch the following graphs, labelling all key features.

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1. Comment on any similarities/differences between your graphs.
2. Discuss how and affect the behaviour/shape of the graph. Provide examples to support your ideas/conjectures (select a different value of ).
3. Discuss how and affect the number and nature of any turning points/point of inflection. Provide examples to support your ideas/conjectures (select a different value of ).
4. What would happen to the graph and key features if was negative? Investigate.
5. Create an equation of a graph of the form that satisfies the following conditions:

Graph 1:

* Has an -intercept and turning point at

Graph 2:

* Has at least 2 turning points
* Has a negative -intercept

Graph 3:

* Has a stationary point of inflection
* Has a negative -intercept

**Component 3**

In this component you will consider graphs of the form ,   
where are non-zero real numbers and .

1. Consider the family of curves of the form where .  
   Investigate how and affect:

* The location and number of axial intercepts
* The behaviour of the graph
* (The number of turning points/stationary points of inflection)

1. Consider the family of curves of the form where and is a non-negative real number.  
   Investigate how and affect:

* The location and number of axial intercepts
* The behaviour of the graph
* (The number of turning points/stationary points of inflection)

**End of Investigation**