Gymea Technology High School
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Year 12 Mathematics Extension 2

Task 2: Breaking Down Questions – Investigation and Quiz

Due Date: Tuesday 17th June 2025

Task Distributed: 29th May 2025 **Unit**: Using Complex Numbers and Nature of Proof

Task Type: Research Task and Quiz **Task Weighting**: 25%

Outcomes: MEX12-1, MEX12-2, MEX12-4

Task Description
This task will require you to identify, interpret and analyse key verbs and terminology in a range of past HSC questions on the topics outlined below. It will assist you in developing your skills and understanding in how to recognise these key terms in examination style questions and determine how they lead you to the solution you are required to develop. These topics have been selected as they are commonly assessed in the HSC exam each year. The questions you will be analysing will cover the following range of techniques from each topic:

Using Complex Numbers	Nature of Proof
• Prove and use DeMoivre's theorem • Define and determine conjugate roots of polynomials with real coefficients • Solve quadratics with complex coefficients • Examine vector addition and subtraction of complex numbers • Examine the geometrical effects of multiplying complex numbers, rotations by i and conjugates • Determine the nth roots of unity • Solve problems using nth roots of complex numbers • Solve and sketch a range of complex relations (locus of complex numbers)	• Use the formal language and notation of proof • Prove simple results involving numbers • Use proof by contradiction and use examples and counter-examples • Prove results involving inequalities including properties of squares, triangle inequalities, arithmetic means and geometric means • Prove further results of inequalities from these initial proofs

This assessment consists of the following 2 compulsory sections:

Part A: Create a Topic Study Guide

Students will create a Topic Study Guide for the topics outlined above; **Using Complex Numbers** and **Nature of Proof.** The Topic Study Guide will consist of:

- A glossary of the most commonly featured key verbs and topic specific terminology presented in these HSC questions.
- A list of all of the questions presented in the **last two years HSC Exams** that linked to these two topic areas listed above.
- An annotated worked solution to each of these questions.

Students are required to use the scaffold attached as a guide to create their Topic Study Guides. It can be word published or handwritten. Students will create the guide by investigating the **2022, 2023 and 2024 HSC Exam** papers to identify and analyse the questions asked that link to the two topic areas above.

The attached scaffold is separated into three parts:

1. **Question Verb(s) and Terminology:** Students will create a glossary table containing:
    a. **A list of the mathematical verbs that were used in the 2022, 2023 and 2024 papers for these two topic areas.** Each verb must be accompanied by a short explanation of what mathematical process that verb requires you to do.

    b. **A list of the topic terminology that was used in the 2022, 2023 and 2024 papers for each topic area.** These terms are the words that link to a process studied in class. Each term must be accompanied by a short explanation of the mathematical process it links to.

2. **Identified Past HSC Questions:** Students are to identify and copy **at least two questions from each topic** presented in the last three years of HSC exams that link to the two topic areas above. In each question identified, students are also required to highlight the verbs and underline the key terms in this question.

3. **Annotated Worked Solutions:** For every past HSC question identified above, students also need to identify the worked solution for that question and write a short annotation on how the key verb and mathematical terminology in that questions leads you to the solution.

See the scaffold for a worked example from the 2017 paper as a guide.

Part B: Moodle Quiz Assessing Your Glossary Knowledge

Students will sit a short in-class Moodle quiz assessing the knowledge and skills developed through your investigation. The questions will require you to:

- Identify key verbs and terminology in past HSC questions.
- Match definitions to key verbs and key math terms.
- Identify steps to solve a question when presented with a key term
- Solve a range of past HSC multiple-choice questions from the topic areas listed above.

Preparation for this Task

For the Part A component, the following websites may assist you to locate past HSC exams and their marking guidelines:

Students Online

https://studentsonline.nesa.nsw.edu.au/go/pastpapers/

NESA Past HSC Exams

https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/Understanding-the-curriculum/resources/hsc-exam-papers

For the quiz aspect of this task, you will need to prepare by:

- Reviewing class work and past HSC examples from each topic listed above.
- Ensuring all set work is up to date.
- Practice completing examination questions with detailed answers under time pressure. (1 mark = 1.5 minutes).
- Seek teacher assistance for unclear work.
- Review the HSC Reference Sheet. You will be provided with one for the quiz.

NESA Glossary of Key Words

Understand the verb associated with the task. The verb will provide an understanding of the detail needed to successfully answer the question.

- **Evaluate –** Make a judgement based on criteria; determine the value of
- **Factorise –** Use algebraic techniques to write the expression as a product of its factors
- **Find** – Use techniques (generally algebraic) to determine a value or expression
- **Identify –** Recognise and name
- **Prove / Show –** Provide all algebraic steps and working in a logical sequence
- **Simplify** – Use algebraic techniques to write an expression in its simplest form
- **Sketch –** Neatly draw a function on a number plane, clearly showing key features
- **Solve –** Use algebraic techniques to find a solution

Check the NESA Glossary of Key Words for further guidance https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/hsc/hsc-student-guide/glossary-keywords

Details of Submission

Part A:
Using the Study Guide Scaffold provided with this notification, create a Topic Study Guide in its entirety and submit it on the day of the Moodle Quiz: 15th March 2024. Your Study Guide may be handwritten or typed and must be handed in before the Moodle Quiz is sat.
Part B:
For successful completion of Moodle Quiz, you must bring the following equipment.

- Board approved calculator
- Blue or black pen,

The quiz will be sat online using your own device or the computers in the Technology Centre. You will be provided with a HSC Reference Sheet for the quiz.
Students who are absent from the examination, or have a legitimate reason for missing the task, must notify the school before the exam commences. To avoid a zero mark being awarded, any absence must be supported by valid misadventure/illness documentation as outlined in the Year 12 Assessment Booklet.

Teacher Feedback and Student Self-Reflection

- The task will typically be returned to students within 14 days of the due date.
- At this time feedback including information on how to improve will be provided through analysis of the examination questions as a class discussion. Explanation will be provided as requested.
- Students can clarify or seek further feedback by speaking with their teacher or the assessment marker.

Upon return of the task, students will also be expected to complete a self-reflection. This will require students to review incorrect responses by seeking clarification from the teacher. Additionally, students will be required to complete a survey in reflection of the examination.

How does this link to my learning?

- The structure of the questioning style in this task will mirror that of the HSC examination.
- This task will be used by you and your teachers to assess your knowledge and understanding of course outcomes and allow you to refine your skills as you prepare for the HSC examination.
- This task will draw together the above outcomes and assess your ability to apply a range of mathematical skills and techniques that you have covered in class.

Assessment Procedures

All students should be fully aware of the School Assessment Procedures for their year group. These were provided at the beginning of the school year and are available on the school website under the Learning Tab for each year group.

Marking Criteria and Scaffolds

Part B is self-marking and will provide instant feedback on the day of completion. Part A will be marked according to the rubric listed below:

Marking Rubric for Part A

Category	0 Marks	1 Mark	2 Marks	3 Marks
Identification of key HSC verb(s)	Does not identify a question verb or does not show a clear understanding of the verb's meaning.	Correctly identifies at least one verb from a suitable HSC question from both topics and attempts to explain its meaning.	Correctly identifies two verbs from suitable HSC questions for both topic areas and correctly explains their meaning.	Correctly identifies at least five verbs from suitable HSC questions and correctly explains their meaning.
Definitions of key mathematical terms	Does not correctly define any key mathematical terms for either topic or does not show a clear understanding of the terminology.	Correctly identifies at least one key term from both topic areas but the links to the syllabus are not well explained.	Correctly defines at least two key terms from both topic areas and provides sufficient understanding of how they link to syllabus ideas / techniques.	Correctly defines at least three key terms from each of the given topic areas and provides sufficient understanding of how they link to syllabus ideas / techniques.
Identification of questions linked to the topic areas	Does not identify any questions that link to either topic.	Attempts to identify and highlights the verb(s) and underlines the key terminology for at least one HSC question that correctly links to the topics.	Identifies and correctly highlights the verb(s) and underlines the key terminology for at least two questions from the designated exam papers that correctly link the topics.	Identifies and correctly highlights the verb(s) and underlines the key terminology for at least four questions from the designated exam papers that correctly link to the topics.
Annotation showing the breakdown of each identified question	Does not provide a question or does attempt to annotate the given question.	Attempts to annotate an identified question that provides a clear understanding of how the verbs and terms link to the solution.	Correctly annotates at least two of their identified questions in each topic that provides a clear understanding of how the verbs and terms link to the solution.	Correctly annotates all of the identified questions in each topic that provides a clear understanding of how the verbs and terms link to the solution.

Topic Study Guide – Scaffold and Worked Example

Task 1: Identifying the Key Question Verbs and Terminology

When we highlight the verb in the question, it provides us with a guide as to what our solution should look like.

Below is an example of a question from the 2017 HSC paper. For each question, the following has been identified and filled in using the scaffold:

- The question verb(s) linked to a short definition on what this verbs requires us to do mathematically.
- The topic terminology linked to the process it tells us to pursue for that question.
- The worked solution with a short annotation of how these terms lead to the given solution.

By investigating the 2020 and 2021 HSC Papers from NESA at the link above, you need to identify the question verb(s) used in these HSC's (at least three commonly used question verbs across both topic areas) and at least three commonly used topic terms in each of the topic areas. These go into the topic glossary above your list of identified questions and annotated solutions. Once completed, you should have a separate Study Guide for both topics that lists the terms you need to remember and how you apply them to past HSC questions for each topic.

Study Guide Scaffold

Further Rates of Change – Topic Study Guide	
Verb	**Definition**
List the verbs here for each question you identify from the past HSC's that link to this topic.	*Provide their mathematical meaning here (what does this question require me to do?).*
Key Terms	**Definition**
List the specific topic terms here for each question you identify from the past HSC's that link to this topic.	*Provide a short explanation of the mathematical process this word links to here. This may include a formula or picture / graphic.*

Questions Appearing in Past HSC Papers	
Question Name	*Write the name of the question here in the format:* *Year HSC Exam Question Number Section*
Copy or paste the identified question here and • *highlight all of the key verbs/terms* • *underline the required data*	
Worked Solution	**Annotation**
Copy or paste the worked solution here	*Write a brief explanation of how each line of working links to the terms you have underlined in the question above*

Use the example below as a guide.

Worked Example

Further Rates of Change – Topic Study Guide	
Question Verb(s)	**Definition**
At what (Evaluate)	*Find the value or the numerical answer.*
Key Terms	**Definition**
Circular	*Links to formulas related to circles: $C = 2\pi r$ and $A = \pi r^2$.*
Increases	*The values are positive.*
Constant Rate	*Links to rates of change topic.* *This means one of the derivatives is a constant number value.*
Area Increasing	*By examining which circular formula to use and identifies which rate of change to is be found.*

Questions Appearing in Past HSC Papers	
Question Name	2017 Extension 1 HSC Q8 Multiple Choice

A stone drops into a pond, creating a circular ripple. The radius of the ripple increases from 0 cm, at a constant rate of 5 cm s^{-1}.

At what rate is the area enclosed within the ripple increasing when the radius is 15 cm?

A. 25π cm^2 s^{-1}

B. 30π cm^2 s^{-1}

C. 150π cm^2 s^{-1}

D. 225π cm^2 s^{-1}

Worked Solution	Annotation
$\frac{dr}{dt} = 5 \text{ cm}^2 \text{ s}^{-1}$	*This is the constant rate of change of the radius identified in the second sentence.*
Now, $\frac{dA}{dt} = \frac{dA}{dr} \cdot \frac{dr}{dt}$	*The third sentence asks us to find the rate of change of the circular area with respect to time.*
$A = \pi r^2$ $\frac{dA}{dr} = 2\pi r$	*Hence, we need to rate of the rate of change of the Area with respect to the radius. This comes from differentiating the Area of a Circle formula.*
$\frac{dA}{dt} = \frac{dA}{dr} \cdot \frac{dr}{dt}$	*Substituting these gives the required derivative to be used.*

$= 2\pi r \cdot 5$ $= 10\pi r$ When $r = 15$ $\frac{dA}{dr} = 10\pi \cdot 15$ $= 150\pi \text{ cm}^2 \text{ s}^{-1}$ $\Rightarrow C$	*Finally, substitution of the radius identified in the third sentence finds the rate of change at the point specified.*