Year 12 Mathematics Extension 1

Task 2 – Breaking Down Questions: Investigation and Quiz

Due Date: Wednesday 26/02/20, Period 5 Week 5 Term 1

Gymea Technology High School
INSPIRE. LEARN. SUCCEED.

Date Distributed: Thursday 6ᵗʰ February 2020

Task Weighting: 25%

Outcomes

ME11-4 *applies understanding of the concept of a derivative in the solution of problems, including rates of change, exponential growth and decay and related rates of change*

ME11-5 *uses concepts of permutations and combinations to solve problems involving counting or ordering contexts*

ME12-6 *chooses and uses appropriate technology to solve problems in a range of contexts*

ME12-7 *evaluates and justifies conclusions, communicating a position clearly in appropriate mathematical forms*

ASSESSMENT OUTLINE

1. WHAT AREAS OF LEARNING DOES THIS ASSESSMENT ADDRESS?

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:

Further Rates of Change	Combinatorics and Binomial Expansions
• Recognise the rate of change of a physical quantity as the derivative (gradient function) • Use language to describe rates of change such as at rest, initially, change of direction and increasing at an increasing rate • Find and interpret the rate of change $\frac{dQ}{dt}$ of a given function $Q = f(t)$ • Apply rates of change to displacement, velocity and acceleration • Solve practical growth or decay problems by sketching, analysing and manipulating models of the form $N(t) = Ae^{kt}$ • Establish the simple growth model $\frac{dN}{dt} = kN$ where N is the population size and k is the growth constant • Sketch and solve problems involving a fixed constant P in the form $N(t) = P + Ae^{kt}$ and verify the rate of change as $\frac{dN}{dt} = k(N - P)$ • Develop models and solve problems requiring use of the chain rule	• Use counting techniques to determine total arrangements (Fundamental Counting Principle) • Calculate arrangements in a line or a circle using Factorial Notation • Solve and prove problems using the pigeonhole principle • Use permutations to solve problems, including restrictions with or without repetition • Use combinations to solve problems • Solving practical problems involving permutations and combinations • Use the concept of Pascal's triangle to expand $(x + y)^n$ • Explore and derive identities associated with the coefficients in an expansion

2. WHY IS THE COMPLETION OF THIS ASSESSMENT IMPORTANT?

- This task provides an opportunity for you to investigate and practice identifying and interpreting the key terminology that is presented in HSC questions with a focus on higher order questions. This is a skill that is vital for allowing you to correctly break down unseen questions and identify the mathematical processes to be applied that allow the problem to be solved.
- The completion of this task will provide you with a relevant glossary of important key terms that you can use for future study when approaching end of paper level HSC style questions.
- The questioning style presented in this task will allow you to gain experience with this style of questioning presented in the HSC.

3. WHAT STEPS DO I TAKE TO COMPLETE THIS TASK?

Task Outline

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; **Further Rates of Change** and **Combinatorics and Binomial Expansions.** 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 **2018 and 2019 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 2018 and 2019 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. You need to identify at least three commonly used HSC verbs across the two topic.
    b. **A list of the topic terminology that was used in the 2018 and 2019 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. You need to identify at least three commonly used topic terms across the two topics.
2. **Identified Past HSC Questions:** Students are to identify and copy **every question** presented in the last two years HSC exams that link to the two topic areas above. In each question identified, students are also required to highlight or 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.

Details for 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: February 26th, 2020. 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 11 Assessment Booklet.

4. HOW WILL MARKS BE AWARDED TO MEASURE MY LEARNING?

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 one verb from a suitable HSC question from either topic and attempts to explain its meaning.	Correctly identifies one verb from a suitable HSC question for both topic areas and correctly explains their meaning.	Correctly identifies more than one verb across both topics areas 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 term 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 both 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.	Identifies at least one question from either paper that correctly links to one of the two topics.	Identifies at least one question from either paper that correctly links to both of the topics.	Identifies at least one question from both papers that correctly links to both of 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 highlight / identify the verb(s) and terminology and annotate the solution for at least one of their identified questions, but the annotation is minimal or does not link to the highlighted terms.	Correctly highlights / identifies the verb(s) and terminology for at least one of their identified questions in each topic, but the annotation is brief or does not clearly explaining how the solution links to the highlighted terms.	Correctly highlights / identifies the verb(s) and terminology for at least one of their identified questions in each topic, with an annotation that provides a clear understanding of how the highlighted 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 two questions 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 2018 and 2019 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

<table>
<tr><td colspan="2" align="center">Topic Study Guide</td></tr>
<tr><td>Verb</td><td>Definition</td></tr>
<tr><td>List the verbs here for each question you identify from the past HSC's that link to this topic.</td><td>Provide their mathematical meaning here (what does this question require me to do?).</td></tr>
<tr><td>Key Terms</td><td>Definition</td></tr>
<tr><td>List the specific topic terms here for each question you identify from the past HSC's that link to this topic.</td><td>Provide a short explanation of the mathematical process this word links to here. This may include a formula or picture / graphic.</td></tr>
</table>

<table>
<tr><td colspan="2" align="center">Questions Appearing in Past HSC Papers</td></tr>
<tr><td>Question Name</td><td>Write the name of the question here in the format:
Year HSC Exam Question Number Section</td></tr>
<tr><td colspan="2">Copy or paste the identified question here and

• highlight all of the key verbs/terms
• underline the required data</td></tr>
<tr><td>Worked Solution</td><td>Annotation</td></tr>
<tr><td>Copy or paste the worked solution here</td><td>Write a brief explanation of how each line of working links to the terms you have underlined in the question above</td></tr>
</table>

Use the example below as a guide.

Worked Example

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

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
$\dfrac{dr}{dt} = 5$ cm^2 s^{-1}	This is the constant rate of change of the radius identified in the second sentence.
Now, $\dfrac{dA}{dt} = \dfrac{dA}{dr} \cdot \dfrac{dr}{dt}$	The third sentence asks us to find the rate of change of the circular area with respect to time.
$A = \pi r^2$ $\dfrac{dA}{dr} = 2\pi r$	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.
$\dfrac{dA}{dt} = \dfrac{dA}{dr} \cdot \dfrac{dr}{dt}$ $= 2\pi r \cdot 5$ $= 10\pi r$	Substituting these gives the required derivative to be used.
When $r = 15$ $\dfrac{dA}{dr} = 10\pi \cdot 15$ $= 150\pi$ cm^2 s^{-1} $\Rightarrow C$	Finally, substitution of the radius identified in the third sentence finds the rate of change at the point specified.