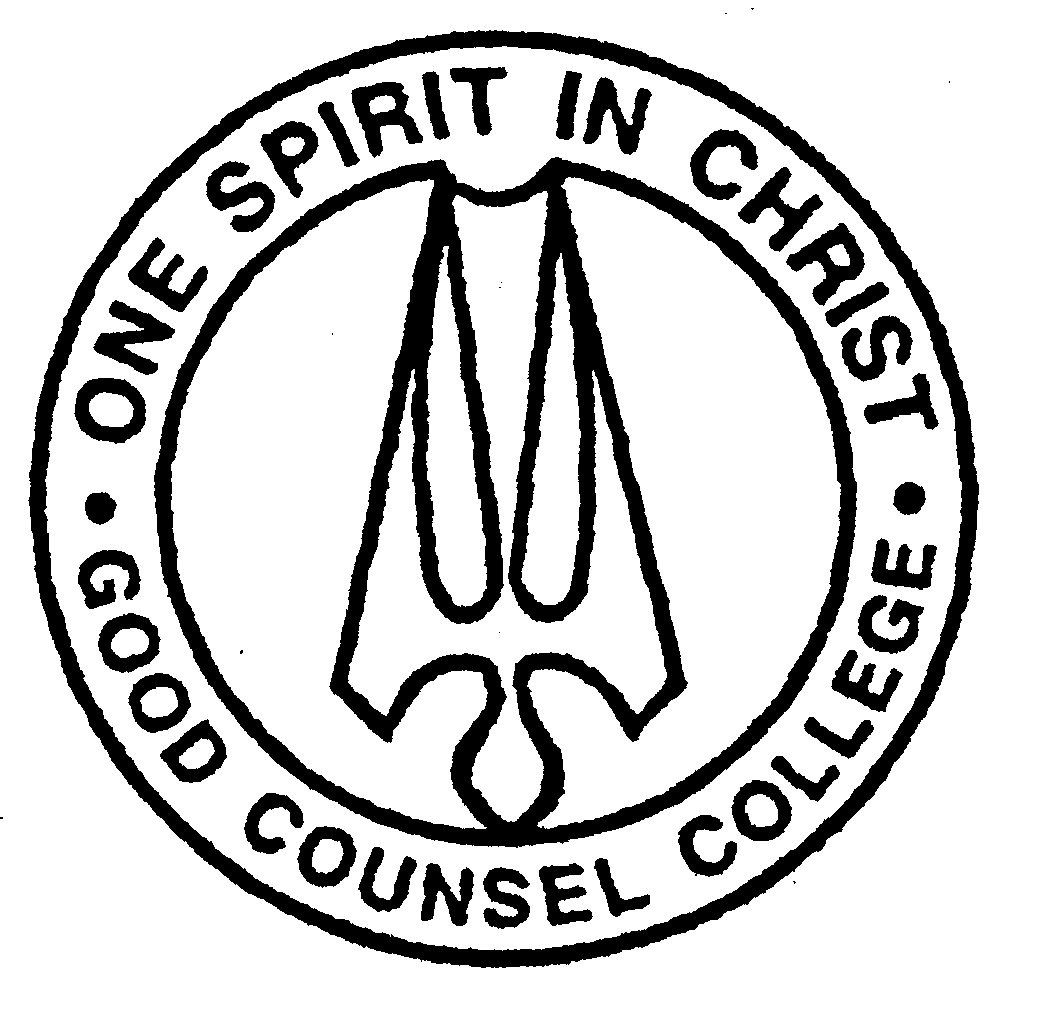
#### GOOD COUNSEL COLLEGE



#### YEAR 10 ADVANCED MATHS

#### PROBLEM-SOLVING AND MODELLING TASK

#### TERM 3



**NAME:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- | --- |
| **Subject** | Advanced Maths | **Instrument no.** | Summative internal assessment 1 |
| **Technique** | Problem-solving and modelling task | | |
| **Unit** | Unit 10.3 | | |
| **Topic** | Topic: Quadratic Equations | | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Conditions** | | | | | | |  |
| **Duration** | 3 weeks (including 3 lessons of class time) | | | | | |  |
| **Mode** | Written report | | **Length** | | Up 5 pages in size 11 font (excluding appendixes) | | |
| **Individual/**  **group** | Individual | | **Other** | | - | |  |
| **Resources**  **available** | The use of technology is required, e.g.   * spreadsheet program and graphing software * graphics calculator * internet access | | | | | |  |
| **Context** | | | | | | |  |
| Many problems (not just mathematical ones) have multiple solutions but often the solution required is the one that is in some sense the ‘best’ and also satisfies certain restrictions. For example, if the problem is to devise a three-course dinner that would ‘satisfy’ all members of your family on a budget of $50, then the constraint is the budget and the ‘best’ solution is one that satisfies the tastes of all family members. There may be multiple solutions in this case or there may be none at all! | | | | | | |  |
| **Task** | | | | | | |  |
| Consider the following mathematical problem:  *A rectangular animal pen with* n *parallel partitions is to be made from a length of fencing* L*. Determine the dimensions of the pen so that the area is* (i) *maximised and* (ii) *minimised.*  You are to investigate the problem both algebraically and numerically. You will need to make and clearly state all assumptions used in solving the problem. You will need to determine the quadratic equation for the total area of your pen and find the dimensions that maximise and minimise the total area using spreadsheet calculations. Your teacher will assign you particular values for *n* and *L*. You must use a variety of tech to Evaluate and Verify your answers.  My values are n=\_\_\_\_\_\_\_\_\_ L=\_\_\_\_\_\_\_\_\_\_  My pen looks like = | | | | | | |  |
| **To complete this task, you must** | | | | | | |  |
| * present your findings as an investigative report based on the approach to problem-solving and mathematical modelling outlined the problem-solving flow chart (attached). * develop a unique response to the problem. | | | | | | |  |
| **Stimulus** | | | | | | |  |
|  | | | | | | |  |
| **Checkpoints** | | | | | | |  |
| 1 Week after issue  2 Weeks after issue  3 Weeks after issue (assessment submission) | | | | | | |  |
| **Criterion** | | | | **Marks allocated** | | **Result** |  |
| **Formulate**  Assessment objectives 1, 2, 5 | | | | **4** | |  |  |
| **Solve**  Assessment objectives 1, 6 | | | | **7** | |  |  |
| **Evaluate and verify**  Assessment objectives 4, 5 | | | | **5** | |  |  |
| **Communicate**  Assessment objectives 3 | | | | **4** | |  |  |
| **Total** | | | | **20** | |  |  |
| **Authentication strategies** | | * Student progress will be documented and copies of student responses collected at the checkpoints. * Each student will produce a unique response by using individualised data and producing unique reports. * Students must submit a declaration of authenticity (see below). | | | | |  |
| **Scaffolding** | | The approach to problem-solving and modelling on the following page must be used. | | | | |  |

**Declaration of authenticity:**

I declare that is work is my own and that help, including the extent of this help, received from other persons has been fully described and acknowledged in the report.

Signed:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_\_\_\_\_\_\_

**Approach to Problem-Solving & Mathematical Modelling**

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| --- | --- |
|  | Once you understand what the problem is asking, you must design a plan to solve the problem. Translate the problem into a mathematically purposeful representation by first determining the applicable mathematical and/or statistical principles, concepts, techniques and technology that are required to make progress with the problem, then list the mathematical techniques and procedures you will use to develop the response. Consider how you will determine the data values that lie on your chosen curve and what methods you will use to generate the model. Appropriate assumptions, variables and observations must be identified and documented, based on the logic of a proposed solution and/or model.  In mathematical modelling, formulating a model involves the process of mathematisation ─ moving from the real world to the mathematical world. |
| Select and apply mathematical and/or statistical procedures, concepts and techniques previously learnt to solve the mathematical problem to be addressed through your model. Possible approaches are wide-ranging and include synthesising and refining the polynomial model and generating and testing the feasibility of the polynomials of higher order, as well as using standard mathematical techniques.  This process may require returning to your initial observations and assumptions and reconsidering and modifying them to ensure the problem has been solved or can actually be solved.  Solutions can be found using algebraic, graphic and technological methods. |
| Icon  Description automatically generatedOnce a possible solution has been achieved, you need to consider the reasonableness of the solution and/or the utility of the model in terms of the problem. Evaluate your results and make a judgment about the solution(s) to the problem in relation to the original issue, statement or question.  This involves exploring the strengths and limitations of your solution and/or model. Where necessary, this will require going back through the process to further refine your solution and/or model. In mathematical modelling, you must check that the output of your model provides a valid solution to the real-world problem it has been designed to address.  Use both a residual analysis and the correlation coefficient to interpret the results of the mathematics compared with the original task. |
| Icon  Description automatically generated with low confidenceThe development of solutions and models to abstract and real-world problems must be capable of being evaluated and used by others and so need to be communicated clearly and fully. Communicate your findings systematically and concisely using mathematical, statistical and everyday language in a structured report. Draw conclusions, discussing the key results and the strengths and limitations of the solution and/or model. You could offer further explanation, justification, and/or recommendations, framed in the context of the initial problem. |
|  |

**Instrument-specific marking guide (ISMG)**



|  |  |  |
| --- | --- | --- |
| **Criterion: Formulate (F) The student work has the following characteristics:** | **Marks** |  |
| • documentation of appropriate assumptions  • accurate documentation of relevant observations  • accurate translation of all aspects of the problem by identifying mathematical concepts and techniques. | 3–4 |  |
| • statement of some relevant observations  • translation of simple aspects of the problem by identifying mathematical concepts and techniques. | 1–2 |  |
| • does not satisfy any of the descriptors above. | 0 |  |
| **Criterion: Solve (S) The student work has the following characteristics:** | **Marks** |  |
| • use of complex procedures to reach an accurate solution  • discerning application of mathematical concepts and techniques relevant to the task  • efficient use of technology. | 6–7 |  |
| • use of complex procedures to reach a reasonable solution  • application of mathematical concepts and techniques relevant to the task  • appropriate use of technology. | 4–5 |  |
| • use of simple procedures to make some progress towards a solution  • simplistic application of mathematical concepts and techniques relevant to the task  • superficial use of technology. | 2–3 |  |
| • isolated use of technology or procedures relevant to the task. | 1 |  |
| • does not satisfy any of the descriptors above. | 0 |  |
| **Criterion: Evaluate and verify (EV) The student work has the following characteristics:** | **Marks** |  |
| • justification and explanation of procedures used and decisions made using mathematical reasoning  • evaluate the reasonableness of solutions by considering the results, assumptions and/or observations  • evaluation of relevant strengths and limitations of the solution and/or model. | 4–5 |  |
| • explanation of procedures used and decisions made  • statement about the reasonableness of solutions by considering the context of the task  • statement about relevant strengths and limitations of the solution and/or model. | 2–3 |  |
| • statement about procedures, decisions and/or the reasonableness of solutions. | 1 |  |
| • does not satisfy any of the descriptors above. | 0 |  |
| **Criterion: Communicate (C) The student work has the following characteristics:** | **Marks** | |
| • correct use of appropriate mathematical, statistical and everyday language and conventions to develop the response  • coherent and concise organisation of the response, appropriate to the genre, including a suitable introduction, body and conclusion, which can be read independently of the task sheet. | 3–4 | |
| • use of some appropriate mathematical, statistical and everyday language and conventions to develop the response  • adequate organisation of the response. | 1–2 | |
| • does not satisfy any of the descriptors above. | 0 | |

|  |  |  |
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| **Criterion** | **Marks allocated** | **Result** |
| **Formulate** Assessment objectives 1, 2, 5 | **4** |  |
| **Solve** Assessment objectives 1, 6 | **7** |  |
| **Evaluate and verify** Assessment objectives 4, 5 | **5** |  |
| **Communicate** Assessment objectives 3 | **4** |  |
| **Total** | **20** |  |

[Link to QCAA for all terms](https://www.qcaa.qld.edu.au/portal/syllabus/?organisation=dba71b6e-a2c2-4eda-a2d9-6bd1ebc62ebd" \l "!/app/dba71b6e-a2c2-4eda-a2d9-6bd1ebc62ebd/syllabus/)

**Glossary for Methods ISMG**

|  |  |
| --- | --- |
| **Term** | **Explanation** |
| accurate | precise and exact; to the point; consistent with or exactly conforming to a truth, standard, rule, model, convention or known facts; free from error or defect; meticulous; correct in all details |
| apply | use knowledge and understanding in response to a given situation or circumstance; carry out or use a procedure in a given or particular situation |
| appropriate | acceptable; suitable or fitting for a particular purpose, circumstance, context, etc. |
| aspect | a particular part of a feature of something; a facet, phase or part of a whole |
| assumptions | conditions that are stated to be true when beginning to solve a problem |
| coherent | having a natural or due agreement of parts; connected; consistent; logical, orderly; well-structured and makes sense; rational, with parts that are harmonious; having an internally consistent relation of parts |
| communicate | convey knowledge and/or understandings to others; make known; transmit |
| complex | composed or consisting of many different and interconnected parts or factors; compound; composite; characterised by an involved combination of parts; complicated; intricate; a complex whole or system; a complicated assembly of particulars |
| concise | expressing much in few words; giving a lot of information clearly and in a few words; brief, comprehensive and to the point; succinct, clear, without repetition of information |
| consider | think deliberately or carefully about something, typically before making a decision; take something into account when making a judgment; view attentively or scrutinise; reflect on |
| decide | reach a resolution as a result of consideration; make a choice from a number of alternatives |
| discerning | discriminating; showing intellectual perception; showing good judgment; making thoughtful and astute choices; selected for value or relevance |
| document | support (e.g. an assertion, claim, statement) with evidence (e.g. decisive information, written references, citations) |
| draw conclusions | make a judgment based on reasoning and evidence |
| evaluate | make an appraisal by weighing up or assessing strengths, implications and limitations; make judgments about ideas, works, solutions or methods in relation to selected criteria; examine and determine the merit, value or significance of something, based on criteria |
| identify | distinguish; locate, recognise and name; establish or indicate who or what someone or something is; provide an answer from a number of possibilities; recognise and state a distinguishing factor or feature |
| inappropriate | not suitable or proper in the circumstances |
| ISMG | instrument-specific marking guide; a tool for marking that describes the characteristics evident in student responses and aligns with the identified objectives for the assessment  (see ‘assessment objectives’) |
| justify | give reasons or evidence to support an answer, response or conclusion; show or prove how an argument, statement or conclusion is right or reasonable |
| make decisions | select from available options; weigh up positives and negatives of each option and consider all the alternatives to arrive at a position |
| observations | data or information required to solve a mathematical problem and/or develop a mathematical model; empirical evidence |
| procedural vocabulary | instructional terms used in a mathematical context (e.g. calculate, convert, determine, identify, justify, show, sketch, solve, state). |
| reasonableness of solutions | to justify solutions obtained with or without technology using everyday language, mathematical language or a combination of both; may be applied to calculations to check working, or to questions that require a relationship back to the context |
| relevant | bearing upon or connected with the matter in hand; to the purpose; applicable and pertinent; having a direct bearing on |
| simple | easy to understand, deal with and use; not complex or complicated; plain; not elaborate or artificial;  may concern a single or basic aspect; involving few elements, components or steps |
| solve | find an answer to, explanation for, or means of dealing with (e.g. a problem);  work out the answer or solution to (e.g. a mathematical problem); obtain the answer/s using algebraic, numerical and/or graphical methods |
| statement | a sentence or assertion |
| suitable | appropriate; fitting; conforming or agreeing in nature, condition, or action |
| technical vocabulary | terms that have a precise mathematical meaning (e.g. categorical data, chain rule, decimal fraction, imaginary number, log laws, linear regression, sine rule, whole number); may include everyday words used in a mathematical context (e.g. capacity, differentiate, evaluate, integrate, order, property, sample, union) |
| valid | sound, just or well-founded; authoritative; having a sound basis in logic or fact (of an argument or point); reasonable or cogent; able to be supported; legitimate and defensible; applicable |

**Introduction** – you start here.

