Sample Assessment Tasks

Mathematics Specialist

ATAR Year 11

**Acknowledgement of Country**

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Sample assessment task

Mathematics Specialist – ATAR Year 11

Task 2 – Unit 1

**Assessment type:** Response

**Conditions:** Time for the task: up to 55 minutes

In class, under test conditions

**Materials required:** Section one: calculator-free

Standard writing equipment

Section two: calculator assumed

Calculator with CAS capability (to be provided by the student)

**Other materials allowed:** Drawing templates, one A4 page of notes in Section two

**Marks available: 61 marks**

Section one: calculator-free – 32 marks

Section two: calculator assumed – 29 marks

**Task weighting: 7%**

Section one: calculator-free (32 marks)

Time allowed: 30 minutes

Question 1 (8 marks)

The position vectors of points A and B and C are , and respectively.

1. Determine:
3. the value(s) of so that
4. Show that

Question 2 (3 marks)

Given the points F = (3, 7) and G = (9, 5), determine the exact value that the vector must be multiplied by so that the length of the vector is 20 units.

Question 3 (6 marks)

A cyclist has an initial position vector of 3kmwith respect to Perth. She cycles towards Midland with a constant velocity of 8km h-1.

1. State her speed.
2. Determine her position with respect to Perth after 1½ hours.
3. Determine her distance from Perth.

Question 4 (7 marks)

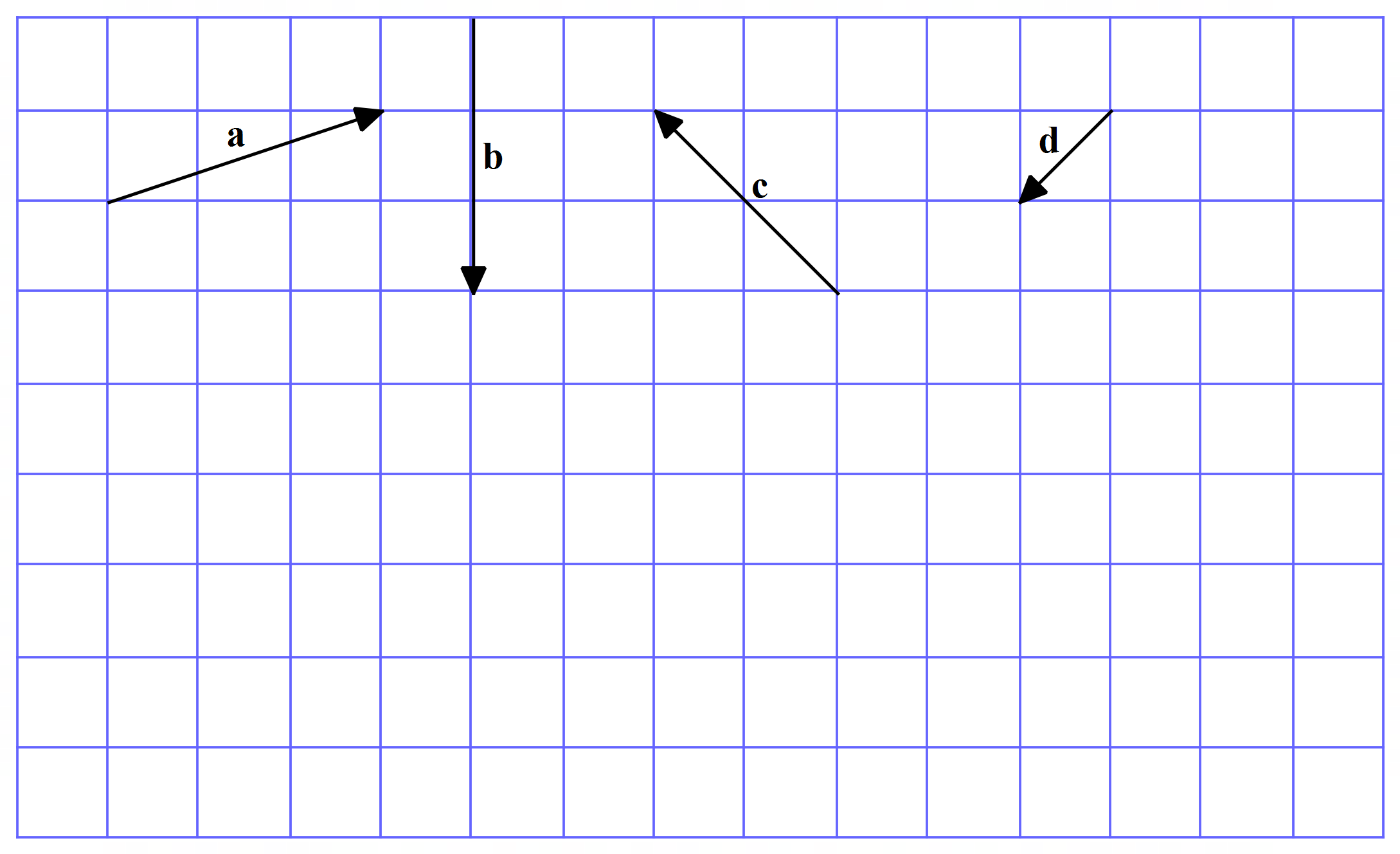
Given the position vectors and determine:

1. a vector parallel to and 2.5 units in length
2. a unit vector perpendicular to

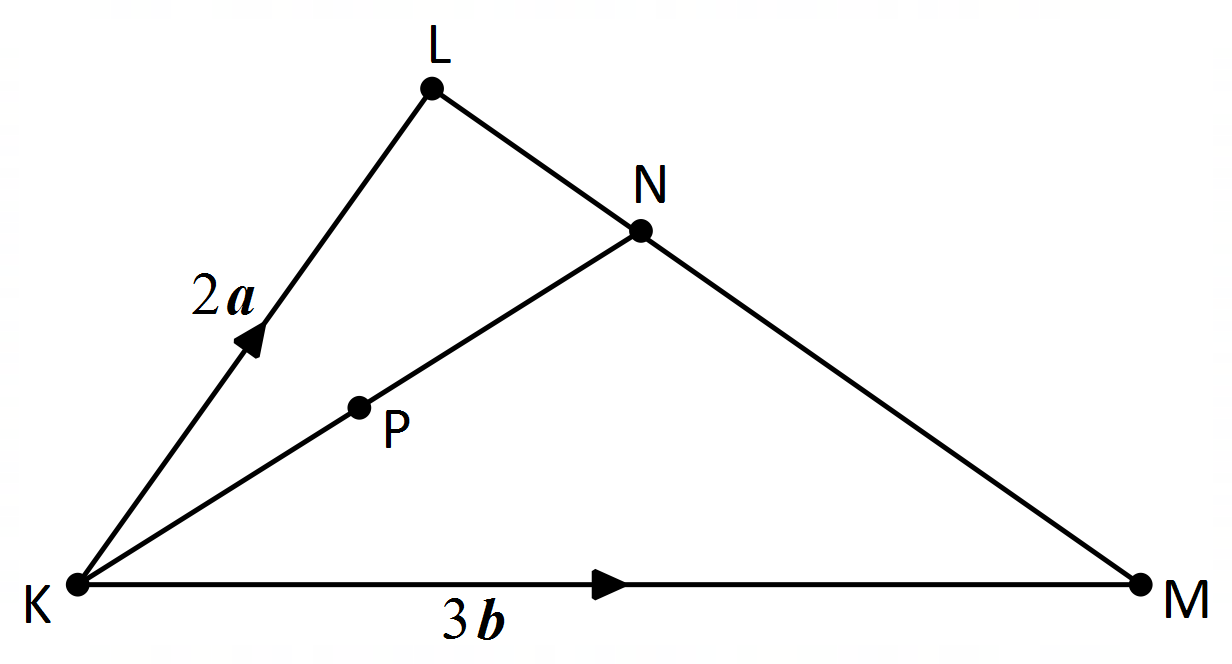
Question 5 (4 marks)

The vectors **a, b, c** and **d** are shown on the grid below.

1. Draw and label the vector
2. **a** + **c**
3. 3**d** – **b**
4. Express the vector **b** in terms of **a**, **c** and **d.**



Question 6 (4 marks)

KLM is a scalene triangle where and

Point P is positioned such that

Show that

Section two: calculator assumed (29 marks)

Time allowed: 25 minutes

Question 7 (6 marks)

Two sides of a parallelogram are defined by the vectors and where , and

1. Determine the vectors and that define the other two sides.
2. Determine the size of the internal obtuse angle of the parallelogram.

Question 8 (4 marks)

A surfer is paddling in the ocean at 3.1 km h-1 parallel to the shore. The current is moving away from the shore at 2.6 km h-1 on an angle of 39° to the shore. If the surfer’s speed is decreased by the current, determine the true direction and speed of the surfer.

Question 9 (10 marks)

A hiker leaves camp and walks 4 kilometres on a bearing of 035°. He then turns and walks on a bearing of 119° for 5 kilometres.

1. Calculate the distance and direction he will need to travel to get back to camp. (4 marks)
2. Calculate the **i** and **j** components for stage one and stage two of his walk. (2 marks)
3. Show clearly the equivalence, in **i** and **j** component form, between the solution in (a) and your answers in (b). (4 marks)

Question 10 (5 marks)

Given the vectors **a** and **b** are such that and

1. determine the scalar projection of
2. onto the -axis
3. onto the -axis
4. determine the exact projection vector of **a** on **b**

Question 11 (4 marks)

Two tugboats are towing a barge into the harbour. The first tug is pulling with a force of 2825 N at an angle of 42° to the left of the direction that the barge is travelling in, while the second tug is pulling the barge at an angle of 29° to the right of the bow, as shown in the diagram below. Calculate, to the nearest 10 N, the magnitude of the force that needs to be applied by the second barge for the barge to continue in a straight line. Hence, determine the magnitude of the resulting force applied to the barge.



29°

42°

Hjem. (2007). Tugs [adapted image].

Retrieved from <https://search.creativecommons.org/photos/683eb7e4-fe1c-423a-921d-77a33e4c10c6>

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Solutions for sample response Unit 1

Section one: calculator-free (32 marks)

Question 1(a) (5 marks)

|  |  |
| --- | --- |
| **Solution** | |
| 1. **a** + *k***c** = | |
| **Behaviours** | **Marks** |
| 1. Determines the vector correctly 2. Determines the vector correctly 3. Determines the vector expression for **a** + *k***c** correctly   Writes an expression for the magnitude of **a** + *k***c** correctly  Correctly identifies the two solutions for *k* | 1  1  1  1  1 |

Question 1(b) (3 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Determines the correct vector for **b** + **c**  Demonstrates the use of the dot product to simplify the left-hand side correctly  Demonstrates the use of the dot product to simplify the right-hand side correctly | 1  1  1 |

Question 2 (3 marks)

|  |  |
| --- | --- |
| **Solution** | |
| =      must be multiplied by | |
| **Behaviours** | **Marks** |
| Determines the vector correctly  Calculates the magnitude of correctly  States the correct scale factor | 1  1  1 |

Question 3(a) (2 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Calculates the magnitude correctly  States the speed correctly, including units | 1  1 |

Question 3(b) (2 marks)

|  |  |
| --- | --- |
| **Solution** | |
| km from Perth | |
| **Behaviours** | **Marks** |
| Writes a correct expression for the position of the cyclist after 1½ hours  States the position correctly, including units | 1  1 |

Question 3(c) (2 marks)

|  |  |
| --- | --- |
| **Solution** | |
| from Perth | |
| **Behaviours** | **Marks** |
| Calculates the magnitude of correctly  States the distance correctly including units | 1  1 |

Question 4(a) (3 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Correctly determines **a** + **b**  Correctly determines the magnitude of **a** + **b**  Correctly scales the vector by | 1  1  1 |

Question 4(b) (4 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Determines a correct equation for the dot product of the two perpendicular vectors  Determines a correct equation for the magnitude of the unit vector  Solves the simultaneous equations to correctly determine a possible value for *y*  Determines a vector that satisfies both conditions correctly | 1  1  1  1 |

Question 5(a) (2 marks)

|  |  |
| --- | --- |
| **Solution** | |
| **a+c**  3**d - b** | |
| **Behaviours** | **Marks** |
| Draws and labels the vector to represent **a** + **c** correctly | 1 |
| Draws and labels the vector to represent 3**d** – **b** correctly | 1 |

Question 5(b) (2 marks)

|  |  |
| --- | --- |
| **Solution** | |
| **a + c + d =** | |
| **Behaviours** | **Marks** |
| Expresses vector **b** in terms of **a**, **c** and **d** correctly (multiple solutions possible)  Justifies the solution either algebraically or graphically | 1  1 |

Question 6 (4 marks)

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Writes an expression for in terms of , and correctly  Expresses in terms of **a** and **b** correctly  Expresses in terms of **a** and **b** correctly  Correctly manipulates the expression formed to show equivalence | 1  1  1  1 |

Section two: calculator-assumed (29 marks)

**Question 7(a) (3 marks)**

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| Identifies two pairs of parallel vectors  Determines correctly  Determines correctly | 1  1  1 |

**Question 7(b) (3 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| angle required is | |
| **Behaviours** | **Marks** |
| Calculates the dot product correctly  Calculates the acute angle correctly  Gives the obtuse angle between the vectors | 1  1  1 |

**Question 8 (4 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| θ  *r*    Surfer is moving at km h–1  shore  at an angle of away from the shore | |
| **Behaviours** | **Marks** |
| Creates a diagram to correctly add the vectors  Determines the resulting speed of the surfer  Determines the resulting vector angle of the surfer  Expresses the solution in terms of a direction with respect to the shore | 1  1  1  1 |

**Question 9(a) (4 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| The hiker will need to travel km on a bearing of | |
| **Behaviours** | **Marks** |
| Creates a diagram to add the vectors and determines the included angle correctly  Calculates the distance back to the camp  Calculates the angle between the last leg and return journey  Determines the direction back to camp as a correct bearing | 1  1  1  1 |

**Question 9(b) (2 marks)**

|  |  |  |
| --- | --- | --- |
| **Solution** | | |
| Stage one: | Stage two: | |
| **Behaviours** | | **Marks** |
| States the stage one components correctly  States the stage two components correctly | | 1  1 |

**Question 9(c) (4 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| Return journey from (a): km on a bearing of      Stage one + stage two (b): +    Back to camp will be reverse direction: **,** which is equivalent to the return journey of km on a bearing of, (**.** | |
| **Behaviours** | **Marks** |
| Expresses the return journey from (a) in component form correctly  Adds vectors for stage one and two in component form  States the reverse direction required for the sum of stage one and two  States equivalence, commenting on rounding error if required | 1  1  1  1 |

**Question 10(a) (2 marks)**

|  |  |
| --- | --- |
| **Solution** | |
|  | |
| **Behaviours** | **Marks** |
| States the projection on the axis as the correct scalar value | 1 |
| States the projection on the axis as the correct scalar value | 1 |

**Question 10(b) (3 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| Scalar projection | |
| **Behaviours** | **Marks** |
| Determines the unit vector correctly  Calculates the scalar projection correctly  Determines the projection vector | 1  1  1 |

**Question 11 (4 marks)**

|  |  |
| --- | --- |
| **Solution** | |
| The second tugboat must pull with a force of  and the resulting force applied will have a magnitude of | |
| **Behaviours** | **Marks** |
| Creates a diagram to show the addition of the vectors and determines the included angle correctly  Calculates the second force, *t*, correctly  Calculates the resulting force being applied to the barge, *u*  Rounds all solutions to the nearest ten correctly | 1  1  1  1 |

Sample assessment task

Mathematics Specialist – ATAR Year 11

Task 7 – Unit 2

**Assessment type:** Investigation

**Conditions:** The investigation will be completed over one week. Students will be encouraged to work independently to complete the task and may use any appropriate technology.

Note: while the Authority provides sample assessment tasks for guidance, it is the expectation of the Authority that teachers will develop tasks customised to reflect their school’s context and the needs of the student cohort. This resource is available on a public website and use of the resource without modification may affect the integrity of the assessment.

**Task weighting:** 7% of the school mark for this pair of units

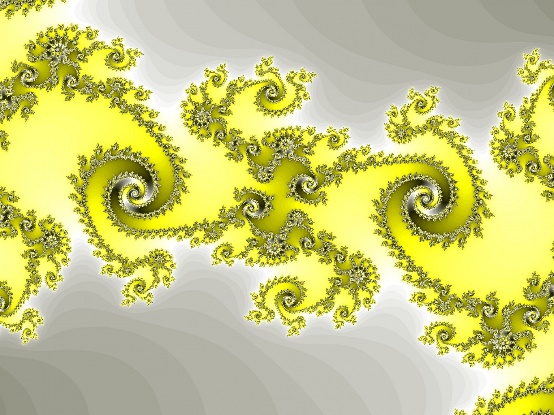
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Complex numbers and the complex plane (36 marks)

Given , investigate the nature of the curve formed by joining together in succession on the Complex Plane, the points formed by , for different values of and .

As you complete this task, take care to clearly

* identify and organise relevant information **(7 marks)**
* choose effective models and methods and carry through correctly **(7 marks)**
* follow mathematical convention and attend to accuracy **(9 marks)**
* link mathematical results to data and context to reach conclusions **(7 marks)**
* communicate mathematical reasoning, results and conclusions **(6 marks)**



Fractal, rendering, spiral, abstract, yellow [Image]. Public domain.

Marking key for sample assessment task 7 – Unit 2

**Identifies and organises relevant information**

|  |  |
| --- | --- |
| **Behaviours** | **Marks** |
| Writes a detailed outline of the investigation, identifying all the important elements of the problem and showing an understanding of the relationship between them; defines relevant parameters for the variables, explains an appropriate and systematic strategy to be applied and identifies appropriate assumptions | 6–7 |
| Writes a detailed outline of the investigation, accurately documenting mathematical content related to the task, defines relevant parameters for the variables and explains the process to be applied | 5 |
| Writes a detailed outline of the investigation, accurately documenting mathematical content related to the task and defines relevant parameters for the variables | 3–4 |
| Writes an outline of the investigation, identifying mathematical content supplied with the task | 2 |
| Writes a simple restatement of the task | 1 |
| **Subtotal** | **/7** |

**Chooses effective models and methods and carries through correctly (including appropriate use of technology)**

|  |  |
| --- | --- |
| **Behaviours** | **Marks** |
| Chooses an efficient and systematic method to investigate the problem, including appropriate and effective use of technology for the mathematical context being considered; and applies the method correctly and consistently throughout the task | 5–7 |
| Chooses an efficient method to investigate the problem, including some use of technology, and applies the method consistently throughout the task | 3–4 |
| Chooses a simple method and applies the method consistently throughout the task | 2 |
| Chooses a simple method to make some progress towards a solution | 1 |
| **Subtotal** | **/7** |

**Follows mathematical conventions and attends to accuracy**

|  |  |
| --- | --- |
| **Behaviours** | **Marks** |
| Applies mathematical procedures with accuracy, demonstrates complete understanding of the mathematical concepts and principles and the relationships between the important elements of the problem  Provides appropriate interpretation and consistent use of mathematical terminology, symbols and conventions in graphing and calculations | 8–9 |
| Applies mathematical procedures with accuracy, demonstrates understanding of the mathematical concepts and principles and the relationships between the important elements of the problem  Provides appropriate interpretation and use of mathematical terminology, symbols and conventions in graphing and calculations | 6–7 |
| Applies mathematical procedures with some accuracy, demonstrates understanding of some mathematical concepts and principles in attempts to identify relationships  Provides appropriate interpretation and makes some use of mathematical terminology, symbols and conventions in graphing and calculations | 4–5 |
| Applies mathematical procedures with some accuracy, and attempts to identify relationships between elements of the problem | 2–3 |
| Attempts to apply mathematical procedures to investigate the problem | 1 |
| **Subtotal** | **/9** |

**Links mathematical results to data and contexts to reach reasonable conclusions**

|  |  |
| --- | --- |
| **Behaviours** | **Marks** |
| Organises and links findings to make clear connections between all algebraic and graphical representations and makes inferences from analysis to draw conclusions across all domains | 6–7 |
| Organises and links findings to make clear connections between all algebraic and graphical representations and draws conclusions for the domain of the task | 5 |
| Organises and links findings to make clear connections between algebraic and graphical representations and draws some valid conclusions | 3–4 |
| Links findings to make connections between some algebraic and graphical representations | 1–2 |
| **Subtotal** | **/7** |

**Communicates mathematical reasoning, results and conclusions**

|  |  |
| --- | --- |
| **Behaviours** | **Marks** |
| Provides a complete response that summarises the findings with clear, unambiguous explanations and/or descriptions using mathematical language and including supporting diagrams linked back to the context of the original problem  Includes logical justification of the possible limitation of the results and recognition of assumptions made  Provides a coherent and organised presentation of the investigation report, including acknowledgement of resources where appropriate | 5–6 |
| Communicates findings in a systematic and concise way using mathematical language, linking the solution to the original problem and acknowledging resources where appropriate | 3–4 |
| Communicates findings in a systematic way but with poor use of mathematical language | 2 |
| Presents simple conclusions that are not organised or supported by data or calculations | 1 |
| **Subtotal** | **/6** |
| **Total** | **/36** |