**MATHEMATICS SPECIALIST**

**MAWA Year 12 Examination 2018**

**Calculator-free**

# Marking Key

© MAWA, 2018

**Licence Agreement**

This examination is Copyright but may be freely used within the school that purchases this licence.

* The items that are contained in this examination are to be used solely in the school for which they are purchased.
* They are not to be shared in any manner with a school which has not purchased their own licence.
* The items and the solutions/marking keys are to be kept confidentially and not copied or made available to anyone who is not a teacher at the school. Teachers may give feedback to students in the form of showing them how the work is marked but students are not to retain a copy of the paper or marking guide until the agreed release date stipulated in the purchasing agreement/licence.

The release date for this exam and marking scheme is

* **the end of week 8 of term 2, 2018**

**Question 1 (4 marks)**

|  |  |
| --- | --- |
| Solution | |
| Now  and . (note that  )  As PQR is a straight line, these two vectors are parallel and are linearly related.  Inspection of the **k** components show that  =  Comparison of the **i** components gives  .  Comparison of the **j** components gives | |
| Mathematical behaviours | Marks |
| * calculates correctly two of the vectors , and * uses the k components of the two vectors to establish the linear relationship * compares the first components to determine the value of b * compares the second components to determine the value of a | 1  1  1  1 |

**Question 2(a) (9 marks)**

|  |  |
| --- | --- |
| Solution | |
| As  clearly have that.  Also    Turning points at. Also  and.  Function is zero at and | |
| Mathematical behaviours | Marks |
| * identifies correct behaviour for large values of * differentiates using the quotient rule * identifies the co-ordinates of one turning point….. * ……and of the other turning point * identifies where function crosses the co-ordinate axes * draws a neat sketch with a function with properly identified max/min… * …….correct large  behaviour…..   ……..and correct overall shape | 1  2  1  1  1  1  1  1 |

**Question 2b(i) (3 marks)**

|  |  |
| --- | --- |
| * Solution | |
| Denominator of the function is positive.  The part of the curve in (a) that was below the -axis is now reflected in the -axis | |
| Mathematical behaviours | Marks |
| draws a sketch of the required function with evidence of   * recognising that * the reflection of the part of the function lying in  and * a clear discontinuity in the slope of the graph either side of | 1  1  1 |

**Question 2b(ii) (3 marks)**

|  |  |
| --- | --- |
| Solution | |
| Function is now an even function since the denominator is clearly even.  The part of the curve in (a) that was to the right of the -axis is now reflected in the axis | |
| Mathematical behaviours | Marks |
| * indicates an appreciation that the modified function * draws a neat sketch of the required function….   ..with evidence of the reflection of the part of the function lying in | 1  1  1 |

**Question 3 (a) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| Hence | |
| Mathematical behaviours | Marks |
| * gives correct value for * gives correct value for | 1  1 |

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

|  |  |
| --- | --- |
| Solution | |
| and  Hence  Therefore | |
| Mathematical behaviours | Marks |
| * states correct value of  and * deduces correct value of * gives correct value of | 1  1  1 |

**Question 4 (a) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| The direction vector  Thus required vector equation is **r** = **i** – **j** + **k** (**i** + **j** ) | |
| Mathematical behaviours | Marks |
| * calculates correctly the direction vector * writes down an acceptable form of the vector line | 1  1 |

**Question 4 (b) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| The point on the line with the first component  corresponds to    Then **r** =  **i**  **j** + **k** so thatwe have m=-8 and n=1. | |
| Mathematical behaviours | Marks |
| * uses the given point to infer the value of * hence deduces the correct values of m and n | 1  1 |

**Question 4 (c) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| If  Now the z-coordinate is constant so that the Cartesian equation is | |
| Mathematical behaviours | Marks |
| * obtains the correct relationship between  and * deduces the correct equation including the property that  is constant. | 1  1 |

**Question 4 (d) (1 mark)**

|  |  |
| --- | --- |
| Solution | |
| As the co-ordinate is constant, the line lies in the plane  parallel to the -plane | |
| Mathematical behaviours | Marks |
| * characterises the line as being parallel to the -plane | 1 |

**Question 5 (a) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| . Hence  Also the argument of  lies in the second quadrant with | |
| Mathematical behaviours | Marks |
| * states the correct value for * gives the correct value for | 1  1 |

**Question 5 (b) (3 marks)**

|  |  |
| --- | --- |
| Solution | |
| From part (a) we know that  cis and so  cis  Now  and so  cis    So  and  . | |
| Mathematical behaviours | Marks |
| * derives the result that * observes that * deduces the correct values of the real and imaginary parts | 1  1  1 |

**Question 6 (a) (5 marks)**

|  |  |
| --- | --- |
| Solution | |
| Consider the augmented matrix    Thus if  the system will have a unique solution.  If  then the third equation is inconsistent unless .  Hence no solution possible if  and . | |
| Mathematical behaviours | Marks |
| * sets up the augmented matrix * performs correctly one relevant row operation * performs correctly a second relevant row operation * notes that  has to have a particular value for no solution * notes that in addition  must be unequal to another critical value | 1  1  1  1  1 |

**Question 6 (b) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
| If  is to be a unique solution the third equation forces  Moreover we still need  else the systems admits an infinity of solutions | |
| Mathematical behaviours | Marks |
| * substitutes the given solution into the last equation to determine the connection between  and * adds the restriction on  for otherwise the solution is not unique | 1  1 |

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

|  |  |
| --- | --- |
| Solution | |
|  | |
| Mathematical behaviours | Marks |
| * plots correct location for * plots correct location for * plots correct location for | 1  1  1 |

**Question 7 (b) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
|  | |
| Mathematical behaviours | Marks |
| * shows a line segment * plots the correct end-points and -3 and 3 (technically these end points are not in the domain as the argument of 0 is not defined – but no marks need be deducted for not discussing this) | 1  1 |

**Question 7 (c) (2 marks)**

|  |  |
| --- | --- |
| Solution | |
|  | |
| Mathematical behaviours | Marks |
| * plots a circular shape * shows the correct centre at the origin and the radius 3 (again, technically, the points 3 and -3 are not in the domain) | 1  1 |

