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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1** | Uses  to write | **M1** | 1.1b | 3rd  Use the relationship between the roots and coefficients of quadratics to solve problems |
| Solves to find | **A1** | 1.1b |
| Uses  to write | **M1** | 1.1b |
| Solves to find | **A1** | 1.1b |
| (4 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **2a** | Uses  to write | **M1** | 2.2a | 3rd  Use the relationship between the roots and coefficients of quadratics to solve problems |
| Solves to find | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2b** | Uses  to write | **M1** | 2.2a | 3rd  Use the relationship between the roots and coefficients of quadratics to solve problems |
| Solves to find  and concludes | **A1** | 1.1b |
|  | **(2)** |  |  |
| (4 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **3a** | States   and | **B1** | 1.1b | 4th  Find the values of functions of the roots of a cubic equation |
|  | **(1)** |  |  |
| **3b** | Deduces that  is a root. | **M1** | 2.2a | 4th  Use the relationship between the roots and coefficients of cubics to solve problems |
| Finds | **M1** | 1.1b |
| Uses  to state | **A1** | 1.1b |
|  | **(3)** |  |  |
| **3c** | Uses  to write | **M1** | 2.2a | 4th  Use the relationship between the roots and coefficients of cubics to solve problems |
| Solves to find | **A1** | 1.1b |
|  | **(2)** |  |  |
| (6 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **4a** | Multiplies the three given roots together and sets the result equal to 52 or −52. For example  or is seen. | **M1** | 1.1b | 5th  Use the relationship between the roots and coefficients of quartics to solve problems |
| Correctly uses  to find | **A1** | 1.1b |
| Attempts to solve this quadratic using either completing the square or the quadratic formula. | **M1** | 3.1a |
| Correctly finds | **A1** | 1.1b |
| States that the roots of  are | **A1** | 2.2a |
|  | **(5)** |  |  |
| **4b** | Applies the process of finding  (of their three roots found in part **a**) to attempt to find *m*. | **M1** | 3.1a | 5th  Use the relationship between the roots and coefficients of quartics to solve problems |
| Correctly finds *m* = −10 | **A1** | 1.1b |
| Applies the process of using the pair sums to find the value of *n*. For example,  is seen. | **M1** | 3.1a |
| Correctly finds *n* = 37 | **A1** | 1.1b |
|  | **(4)** |  |  |
| (9 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **5a** | States or implies that  is a root. | **M1** | 2.2a | 5th  Use the relationship between the roots and coefficients of quartics to solve problems |
| Uses  to write | **A1** | 3.1a |
| Uses  to write | **A1** | 3.1a |
|  | **(3)** |  |  |
| **5b** | Makes an attempt to solve for  and  for example  is substituted into | **M1** | 2.2a | 5th  Use the relationship between the roots and coefficients of quartics to solve problems |
| Forms a quadratic in  or   or  or equivalent is seen and attempts to solve the quadratic. | **M1** | 3.1a |
| States either  or | **A1** | 1.1b |
| States the roots of the equation are: | **A1** | 2.2a |
|  | **(4)** |  |  |
| **5c** | Makes an attempt to use  to find *n* | **M1** | 3.1a | 5th  Use the relationship between the roots and coefficients of quartics to solve problems |
| Finds *n* = 580 | **A1** | 1.1b |
|  | **(2)** |  |  |
| (9 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **6a** | States   and | **B1** | 1.1b | 4th  Find the values of functions of the roots of a cubic equation |
|  | **(1)** |  |  |
| **6bi** | Makes an attempt to use | **M1** | 3.1a | 4th  Understand and use the rules for products of roots |
| Finds | **A1** | 1.1b |
|  | **(2)** |  |  |
| **6bii** | Makes an attempt to use | **M1** | 3.1a | 4th  Understand and use the rules for sums of squares of roots |
| Finds | **A1** | 1.1b |
|  | **(2)** |  |  |
| **6biii** | Makes an attempt to multiply out | **M1** | 1.1b | 4th  Use the relationship between the roots and coefficients of cubics to solve problems |
| Finds or states | **M1** | 3.1a |
| Finds | **A1** | 1.1b |
|  | **(3)** |  |  |
| (8 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **7** | States | **B1** | 3.1a | 6th  Use sums and products of roots to find equations with linear transformations of the roots of an original equation |
| States | **M1** | 3.1a |
| Makes an attempt to manipulate the equation into the form | **M1** | 1.1b |
| At least two of *a*, *b*, *c* or *d* are correct. | **A1** | 1.1b |
| Fully correct final equation: | **A1** | 1.1b |
| (5 marks) | | | | |
| Notes  **7:** Accept an equation that is a multiple of  most likely  **See also alternative method for first three marks on next page.** | | | | |

**ALTERNATIVE METHOD FOR FIRST THREE MARKS**

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **7** | States   and | **B1** | 3.1a | 6th  Use sums and products of roots to find equations with linear transformations of the roots of an original equation |
|  | Sum of roots:  Pair sum:    Product: | **M1** | 3.1a |
|  | Applies:  *w3* – (their sum roots)*w2* + (their pair sum)*w* – their product = 0 | **M1** | 1.1b |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **8** | States | **B1** | 3.1a | 6th  Use sums and products of roots to find equations with linear transformations of the roots of an original equation |
| States | **M1** | 3.1a |
| Makes an attempt to manipulate the equation into the form | **M1** | 1.1b |
| At least two of *p*, *q*, *r*, *s* and *t* are correct. | **A1** | 1.1b |
| Fully correct final equation: | **A1** | 1.1b |
| (5 marks) | | | | |
| Notes  **See also alternative method for first three marks on next page.** | | | | |

**ALTERNATIVE METHOD FOR FIRST THREE MARKS**

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **8** | States     and | **B1** | 3.1a | 6th  Use sums and products of roots to find equations with linear transformations of the roots of an original equation |
| Sum of roots:  Pair sum:  Triple sum:  Product: | **M1** | 3.1a |
| Applies:  *w4* – (their sum roots)*w3* + (their pair sum)*w2*  – (their triple sum)*w* + their product = 0 | **M1** | 1.1b |