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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1** | Uses  to write   | **M1** | 1.1b | 3rdUse 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 | 3rdUse 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 | 3rdUse 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 | 4thFind the values of functions of the roots of a cubic equation |
|  | **(1)** |  |  |
| **3b** | Deduces that  is a root. | **M1** | 2.2a | 4thUse 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 | 4thUse 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 | 5thUse 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 | 5thUse 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 | 5thUse 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 | 5thUse 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 | 5thUse 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 | 4thFind the values of functions of the roots of a cubic equation |
|  | **(1)** |  |  |
| **6bi** | Makes an attempt to use   | **M1** | 3.1a | 4thUnderstand and use the rules for products of roots |
| Finds  | **A1** | 1.1b |
|  | **(2)** |  |  |
| **6bii** | Makes an attempt to use   | **M1** | 3.1a | 4thUnderstand 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 | 4thUse 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 | 6thUse 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 | 6thUse 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 | 6thUse 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**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **8** | States    and   | **B1** | 3.1a | 6thUse 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 |