**GCSE Mathematics (1MA1) – Higher Tier**

**Surds student-friendly mark scheme**

**Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide to good practice, indicating where marks are given for correct answers. As such, it doesn’t show follow-through marks (marks that are awarded despite errors being made) or special cases.**

**It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme.**

**NOTES ON MARKING PRINCIPLES**

|  |
| --- |
| **Guidance on the use of codes within this mark scheme** |
| M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.P1 – process mark. This mark is generally given for setting up an appropriate process to find a solution in the context of the question.A1 – accuracy mark. This mark is generally given for a correct answer following correct working.B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.C1 – communication mark. This mark is given for explaining your answer or giving a conclusion in context supported by your working.Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer). |

**Question 1 (Total 5 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) | √3 + √(4 × 3) = √3 + 2√3 | M1 | This mark is given for a method to use √12 = √(4 × 3) and simplify |
| 3√3 | A1 | This mark is given for the correct answer only |
| (b) |  | M1 | This mark is given for a method to simplify the power |
|  ×  | M1 | This mark is given rationalising the denominator |
|  | A1 | This mark is given for the correct answer only |

**Question 2 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | √5(√8 + √18) = √5√8 + √5√18 | M1 | This mark is given for expanding brackets |
|  | = √40 + √90= √4√10 + √9√10= 2√10 + 3√10 | M1 | This mark is given for finding an expression in terms of √10 |
|  | = (2 + 3)√10= 5√10*a* = 5 | A1 | This mark is given for the correct answer only |

**Question 3 (Total 2 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | In the denominator on the second line, √3 × −√3 = −3, not 3 | C1 | This mark is given for a correct explanation |
| In the numerator on the second line, √12 = 2√3, not 3√2 | C1 | This mark is given for a correct explanation |

**Question 4 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  ×  =  | M1 | This mark is given for a method to multiply the numerator and denominator by √11 |
| = 2√11 | A1 | This mark is given for the correct answer only |
| (b) |  ×  =  | M1 | This mark is given for a method to multiply the numerator and denominator by 2√3 + 1 |
| (*a* = 6, *b* = 11) | M1 | This mark is given for either a correct numerator or correct denominator seen |
| A1 | This mark is given for a completely correct answer only |

**Question 5 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  |  =  =  =  | C1 | This mark is given for expanding the numerator of the expression |
|  ×  =  = 8√8 + 16 | C1 | This mark is given for rationalising the denominator of the expression |
| = 16(1 + √2) (*a* = 16, *b* = 1) | C1 | This mark is given for correct working to find the values of *a* and *b* |

**Question 6 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | × | 1 | This mark is given for multiplying the numerator and denominator by √2 + 1 |
| = 6√2 + 6 – 4 – 2√2 | 1 | This mark is given for expanding the numerator and collecting terms |
| = 2 + 4√2 so *a* = 2, *b* = 4 | 1 | This mark is given for the correct answer only |

**Question 7 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  ×  | M1 | This method mark is given for intention to multiply numerator and denominator by (5 – √8)  |
| (3 + √2)(5 – √8) = 15 + 5√2 – 3√8 – 4or(5 + √8)(5 – √8) = 25 + 5√8 – 5√8 – 8 | M1 | This method mark is given for correct expansion of either (3 + √2)(5 – √8) or (5 + √8)(5 – √8), at least 3 terms correct or 4 correct terms ignoring signs |
|  =  =  | A1 | This accuracy mark is given for fully correct working leading to the answer shown |

**Question 8 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | 36 + 6√5 – 6√5 −√25 (=31)  | M1 | This mark is given for expanding the brackets |
| Using √31 with numerator & denominator | M1 | This mark is given for rationalising the denominator. |
| √31 | A1 |  |

**Question 9 (Total 3 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  |  | C1 | This mark is given for multiplying both top and bottom of the fraction by √3. |
|  =  | C1 | This mark is given for simplifying the denominator |
|  | C1 | This mark is given for a correct conclusion |

**Question 10 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | (3 − √2)2 = 9 – 3√2 – 3√2 + 2 = 11 – 6√2 | M1 | This mark is given for a method to expand the denominator |
|  ×  | M1 | This mark is given for a method to rationalise the denominator |
| 11 + 6√2 + 11√2 + 12 = 23 +17√2121 – 66√2 + 66√2 + 72 = 49 | M1 | This mark is given for a method to expand correctly either the numerator or the denominator |
| *a* =  | A1 | This mark is given for the correct answer only |
| *b* =  | A1 | This mark is given for the correct answer only |

**Question 11 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  |  ×  | M1 | This mark is given for multiplying the numerator and denominator by 1 + √2 |
|  ×  | M1 | This mark is given for a method to simplify √128 |
|  =  | M1 | This mark is given for a method to expand both the numerator and the denominator |
| = – 20√2 – 28 | A1 | This mark is given for the correct answer only |

Performance data:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Q** | **Taken from**  | **Total Marks available** | **TOPIC** | **Spec Ref** | **AO** | **% Mean marks** | **Edexcel mean averagesMarks of candidates who achieved grade:** |
| **Q** | **Series** | **Paper** | **ALL** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **U** |
| 1a | 18a | June 2019 | 1H | 2 | Number | N8 | 2 | 56 | 1.11 | 1.99 | 1.92 | 1.63 | 1.10 | 0.56 | 0.24 | 0.11 | - | - | 0.08 |
| 1b | 18b | June 2019 | 1H | 3 | Number | N8 | 2 | 28 | 0.85 | 2.54 | 1.78 | 1.12 | 0.62 | 0.29 | 0.11 | 0.04 | - | - | 0.03 |
| 2 | 13 | June 2018 | 1H | 3 | Number | N8 | 2 | 51 | 1.54 | 2.93 | 2.75 | 2.26 | 1.57 | 0.90 | 0.46 | 0.24 | - | - | 0.12 |
| 3a | 20a | June 2018 | 2H | 1 | Number | N8 | 3 | 39 | 0.39 | 0.96 | 0.81 | 0.57 | 0.34 | 0.17 | 0.08 | 0.04 | - | - | 0.02 |
| 3b | 20b | June 2018 | 2H | 1 | Number | N8 | 3 | 45 | 0.45 | 0.91 | 0.78 | 0.61 | 0.43 | 0.27 | 0.17 | 0.11 | - | - | 0.08 |
| 4a | 16a | Nov 2019 | 1H | 2 | Number | N8 | 1 | 28 | 0.56 | 2.00 | 1.89 | 1.58 | 1.19 | 0.76 | 0.25 | 0.06 | - | - | 0.02 |
| 4b | 16b | Nov 2019 | 1H | 3 | Number | N8 | 2 | 11 | 0.34 | 3.00 | 2.46 | 1.37 | 0.74 | 0.34 | 0.04 | 0.00 | - | - | 0.00 |
| 5 | 20 | Nov 2018 | 1H | 3 | Number | N8 | 2 | 11 | 0.34 | 2.60 | 2.30 | 1.39 | 0.84 | 0.46 | 0.10 | 0.02 | - | - | 0.00 |
| 6 | 21 | Nov 2017 | 1H | 3 | Number | N8 | 2 | 5 | 0.14 | 2.50 | 2.21 | 1.15 | 0.53 | 0.24 | 0.04 | 0.01 |  |  | 0.01 |
| 7 | 21 | Mock Set 1  | 1H | 3 | Number | N8 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | 19 | Spec Set 1  | 1H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 18 | Mock Set 2  | 1H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | 19 | Mock Set 3  | 1H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | 20 | Mock Set 4 | 1H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **39** |  |  |  |  | **5.72** | **19.43** | **16.90** | **11.68** | **7.36** | **3.99** | **1.49** | **0.63** |  |  | **0.36** |