**GCSE Mathematics (1MA1)**

**Themed papers – Functions**

**Compiled from student-friendly mark schemes**

**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 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  =  | B1 | This mark is given for the correct answer only |
| (b) | g(1) = 4f(4) =  | M1 | This mark is given for a method to find fg(1) = f(g(1)) |
| f(4) = , fg(1) =  | A1 | This mark is given for the correct answer only |

**Question 2 (Total 7 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) |  | M1 | This mark is given for a method to change the subject, for example *y* = 3*x* – 1 or *y* + 1 = 3*x* |
| A1 | This mark is given for the correct answer only |
| (b) | fg(*x*) = 3(*x*2 + 4) – 1 | M1 | This mark is given for a finding the angle *BDC* |
| gf(*x*) = (3*x* – 1)2 + 4 | M1 | This mark is given for a an appropriate reason stated |
| 3*x*2 + 11 = 2(9*x*2 – 6*x* + 5) | M1 | This mark is for setting up the equation of fg(*x*) = 2gf(*x*) |
| 3*x*2 + 11 = 18*x*2 – 12*x* + 10 | M1 | This mark is given for multiplying out the expression for 2gf(*x*) |
| 15*x*2 – 12*x* – 1 = 0 | C1 | This mark is given for a correct conclusion following from correct working |

**Question 3 (Total 4 mark)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | 4 sin 23° = 4 × 0.3907311= 1.5629245= 1.56 | B1 | This mark is given for the correct answer to three significant figures |
| (b) | g(34) = (2 × 34) – 3 = 65f(65) = 4 sin 65° = 4 × 0.9063077 | M1 | This mark is given for a method to find g(34) and f(65) |
|  = 3.6252311 = 3.63 | A1 | This mark is given for the correct answer to three significant figures |
| (c) | Both the positive and negative square roots are required for a fully correct solution | C1 | This mark is given for a correct statement |

**Question 4 (Total 6 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) | f–1(*x*) =  | C1 | This mark is given for finding an expression for f–1(*x*) |
| f–1(*x*) =  =  = 3 | C1 | This mark is given for correctly substituting 50 into f–1(*x*)  |
| (b) | hg(*x*) = (*x* + 2)2 | P1 | This mark is given for a process to find an expression for hg(*x*) |
| (*x* + 2)2 = 3*x*2 + *x* – 1*x*2 + 4*x* + 4 = 3*x*2 + *x* – 12*x*2 – 3*x* – 5 = 0 | P1 | This mark is given for a process to find a quadratic equation to be solved |
| (2*x* – 5)(*x* + 1) = 0 | P1 | This mark is given for a process to factorise to solve for *x* |
| *x* = –1 and *x* = 2.5 | A1 | This mark is given for the correct answers only |

**Question 5 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | 2((*x* + 1)2 – 1) | C1 | This mark is given for a first step to find gf(*x*) |
| = 2(*x*2 + 2*x* + 1 – 1)= 2*x*2 + 4*x*= 2*x*(*x* + 2) | C1 | This mark is given for a complete chain of reasoning |
| (b) | g–1(*x*) =  + 1 | M1 | This mark is given for a process to find an expression for g–1(*x*) |
| 3.5 + 1 = 4.5 | A1 | This mark is given for the correct answer only |

**Question 6 (Total 7 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) | (–4)2 + 2 = 18 | B1 | This mark is given for a correct answer only |
| (b) | (2*x* – 3)2 + 2 | C1 | This mark is given for a correct first step |
| = 4*x*2 – 6*x* – 6*x* + 9 + 2= 4*x*2 – 12*x* + 11 | C1 | This mark is given for a correct fully correct chain of reasoning that the includes correct expansion of (2*x* – 3)2 |
| (c) | 2(*x*2 + 2) – 3 = 4*x*2 – 12*x* + 11 | P1 | This mark is given for a process to process to find fg(*x*) and form an equation |
| 2*x*2 + 1 = 4*x*2 – 12*x* + 112*x*2 – 12*x* + 10 = 0 | P1 | This mark is given for a process to reduce the equation to the form *ax*2 + *bx* + *c* = 0 |
| (2*x* – 2)(*x* – 5) = 0 | P1 | This mark is given for a process to solve the quadratic equation |
| *x* = 1, *x* = 5 | A1 | This mark is given for a correct answer only |

**Question 7 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | g(2) = (4 × 2) – 1 = 7 | M1 | This mark is given for finding the value of g(2) |
| f(7) = fg(2)= 73 = 343 | A1 | This mark is given for the correct answer only |
| (b) | h(*x*) = (4*x* – 1)3 | M1 | This mark is given for a method to find an expression for h(*x*) |
|  = 4*y* – 1 + 1 = 4*y* | M1 | This mark is given for a method to find h–1(*x*) |
|  | A1 | This mark is given for a correct answer only |

**Question 8 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | ff(*x*) = $\frac{1-\frac{1-x}{1+x}}{1+\frac{1-x}{1+x}}$ | M1 | This mark is given for a method to show ff(*x*) as an unsimplified fraction |
| $$\frac{1+x-(1-x)}{1+x+(1-x)}$$ | M1 | This mark is given for a full method to write either the numerator or denominator as a single fraction |
|  | C1 | This mark is given for a complete method with correct working |
| (b) | f-1(*x*) = $\frac{1-x}{1+x}$ | B1 | This mark is given for a correct answer only |

**Question 9 (Total 8 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) |  +  | M1 | This mark is given for correct substitution into the function |
|  | A1 | This mark is given for the correct answer only |
| (b) | − 2 or 3 | B1 | This mark is given for the correct answer only |
| (c) | f(*x*) =  = 4 | M1 | This mark is given for representing the equation as a single fraction |
|  = 4 = 12*x* – 1 = 4*x*2 – 4*x* – 24 | M1 | This mark is given for simplifying and rearranging to a quadratic equal to zero  |
| 4*x*² − 6*x* − 23 = 0 | A1 | This mark is given for the correct answer only |
| *a* = 4, *b* = 6, *c* = –23 | M1 | This mark is given for a complete method to solve using the quadratic formula |
|  | 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 | 11a | June 2018 | 2H | 1 | Algebra | A7 | 1 | 66 | 0.66 | 0.99 | 0.96 | 0.88 | 0.75 | 0.52 | 0.29 | 0.14 | - | - | 0.08 |
| 1b | 11b | June 2018 | 2H | 2 | Algebra | A7 | 1 | 61 | 1.21 | 1.95 | 1.84 | 1.65 | 1.32 | 0.88 | 0.51 | 0.29 | - | - | 0.14 |
| 2a | 21a | June 2019 | 1H | 2 | Algebra | A7 | 1 | 41 | 0.81 | 1.90 | 1.65 | 1.22 | 0.68 | 0.29 | 0.09 | 0.03 | - | - | 0.03 |
| 2b | 21b | June 2019 | 1H | 5 | Algebra | A7 | 2 | 39 | 1.95 | 4.90 | 4.45 | 3.19 | 1.46 | 0.39 | 0.07 | 0.02 | - | - | 0.02 |
| 3a | 10a | Nov 2018 | 3H | 1 | Algebra | A7 | 1 | 66 | 0.66 | 0.90 | 1.00 | 0.95 | 0.91 | 0.82 | 0.65 | 0.44 | - | - | 0.28 |
| 3b | 10b | Nov 2018 | 3H | 2 | Algebra | A7 | 1 | 22 | 0.44 | 1.80 | 1.88 | 1.52 | 1.18 | 0.67 | 0.13 | 0.03 | - | - | 0.00 |
| 3c | 10c | Nov 2018 | 3H | 1 | Algebra | A7, A18 | 3 | 7 | 0.07 | 0.90 | 0.74 | 0.31 | 0.16 | 0.05 | 0.01 | 0.00 | - | - | 0.00 |
| 4a | 18a | Nov 2019 | 1H | 2 | Algebra | A7 | 2 | 14 | 0.27 | 1.78 | 1.68 | 1.08 | 0.58 | 0.28 | 0.06 | 0.01 | - | - | 0.01 |
| 4b | 18b | Nov 2019 | 1H | 4 | Algebra | A7 | 3 | 6 | 0.22 | 3.78 | 2.27 | 1.14 | 0.42 | 0.09 | 0.01 | 0.00 | - | - | 0.00 |
| 5a | 19a | Nov 2018 | 1H | 2 | Algebra | A4, A7 | 2 | 12 | 0.23 | 1.70 | 1.73 | 1.22 | 0.69 | 0.20 | 0.02 | 0.01 | - | - | 0.00 |
| 5b | 19b | Nov 2018 | 1H | 2 | Algebra | A7 | 1 | 6 | 0.11 | 1.40 | 0.94 | 0.61 | 0.33 | 0.06 | 0.01 | 0.01 | - | - | 0.00 |
| 6a | 20a | Mock Set 1  | 3H | 1 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6b | 20b | Mock Set 1  | 3H | 2 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6b | 20c | Mock Set 1  | 3H | 4 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7a | 21a | Mock Set 3  | 3H | 2 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7b | 21b | Mock Set 3  | 3H | 3 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8a | 20a | Mock Set 4  | 2H | 3 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8b | 20b | Mock Set 4  | 2H | 1 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9a | 21a | Mock Set 2 | 3H | 2 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9b | 21b | Mock Set 2 | 3H | 1 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9c | 21c | Mock Set 2 | 3H | 5 | Algebra | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **48** |  |  |  |  | **6.63** | **22** | **19.14** | **13.77** | **8.48** | **4.25** | **1.85** | **0.98** | **-** | **-** | **0.56** |