**GCSE Mathematics (1MA1)**

**Themed papers – Area and perimeter: Arcs, Sectors and Circles**

**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**

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| --- |
| **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** |
|  | π × 4² ÷ 2 =25.13 |  | This mark is given for finding the area of the semi-circle |
| 64 25.13 =38.86 |  | This mark is given for finding the area of the trapezium |
| 38.86 ÷ 5 × 2 =15.54 |  | This mark is given for finding the sum of *AB* and *DC* |
| 15.54 8 =7.546 |  | This mark is given for a complete process to find the missing length |
| 7.5 |  | This mark is given for an answer in the range of 7.5 to 7.6 |

**Question 2 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | π × 54 (= 169.6460033)  or ( π × 54) ÷ 2 (= 84.82300165) | P1 | This mark is given for process to find the distance around one or both ends of the track |
| 40 × 2 + 169.6460033 (= 249.6460033) | P1 | This mark is given for complete process to find the total length of the track |
| e.g. π × 590 (= 1853.539666 mm)  or π × 0.59 (= 1.8539666 m) | P1 | This mark is given for process to find the circumference of wheel |
| 249.64… ÷ 1.85…  or unrounded answer of 134.6860863 | P1 | This mark is given for complete process to find the number of revolutions in consistent units |
| 135 | A1 | This mark is given for the correct answer only |

**Question 3 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *π* × 72 = 49*π* = 153.938… | P1 | This mark is given for a process to find the area of the circle that the sector is part of |
| × 360 = 93.54 | P1 | This mark is given for a process to find the angle of the sector at *O* |
| × 2 × *π* × 7 = 11.43 | P1 | This mark is given for a process to find the length of the arc *AB* |
| 11.43 + 7 + 7 = 25.43 | A1 | This mark is given for a correct answer in the range 25 to 25.44 |

**Question 4 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *AOB* = 60° | B1 | This mark is given for recognising an angle of 60 at *AOB* |
| *π r* 2 ×  =  = 63.3… | P1 | This mark is given for a process to find the area of the sector *NOQ* |
| *ab* sin *C* = × 72 × sin 60  = 24.5 ×  = 21.2… | P1 | This mark is given for a process to find the area of the triangle *AOB* |
| × 100 | P1 | This mark is given for a process to find the percentage of the sector which is shaded |
| 66.5 | A1 | This mark is given for the correct answer only (in the range 66.5 to 66.6) |

**Question 5 (Total 4 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | Square with side *x* and circle with radius *r*  *π r*² = 49, *r*2 = | M1 | This mark is given for a method to find *r* |
| (2*r*)2 = *x*² + *x*²,  *x*  4*r*2 = 2*x*2  2*r*  2*r*2 = *x*2 | M1 | The mark is given for use of Pythagoras to set up an equation in *x*² |
| = *x*2 | M1 | This mark is given for a method to rearrange to find a value for *x*2 |
| 5.59 | A1 | 5.5 to 5.6 |

**Question 6 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | circumference of **A** : circumference of **B**  = 10 : 9 | M1 | This mark is given for a method to find the ratio of the circumferences of circles **A** and **B** |
| area of **A** : area of **B**  = 102 : 92  = 100 : 81 | A1 | This mark is given for correctly finding the ratio of the areas of circles **A** and **B** |
| (b) | area of **E** : area of **F** = 144 : 100 | P1 | This mark is given for a method to find the ratio of the area of the squares **E** and **F** |
| side of **E** : side of **F**  = √144 : √100  = 12 : 10  = 6 : 5 | A1 | This mark is given for correctly finding the ratio of the sides of the squares **E** and **F** |

**Question 7 (Total 3marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | = 14.0056 | P1 | This mark is given for a process to find the diameter of the circle |
| × 14.0056 × 14.0056 × sin 60°  =  × 14.0056 × 14.0056 × | P1 | This mark is given for a process to use *ab* sin *C* to find the area of the triangle |
| 84.9 | A1 | This mark is given for an answer in the range 84.8 – 85 |

**Question 8 (Total 4 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | 24 × 4 = 96 | P1 | This mark is given for a process to find the length of the rectangle |
| 48 sin 60° = 48 ×  = 24√3  or  √(482 – 242) = 24√3 | P1 | This mark is given for a process to find the perpendicular height of an equilateral triangle of side 48 cm |
| 24 + 24 + 24√3 = 89.569… | P1 | This mark is given for a complete process to find the width of rectangle |
| 8600 (to 3 significant figures) | A1 | This mark is given for a correct answer only |

**Question 9 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *π* × 102 ÷ 2 = 50*π* | M1 | This mark is given for a method to find the area of the semicircle |
| *π* × 202 ÷ 4 = 100*π* | M1 | This mark is given for a method to find the area of the quarter circle |
| 100*π* – 50*π* = 50*π*  20 × 20 = 400 | M1 | This mark is given for a method to find the shaded area and the area of the square |
| = | A1 | This mark is given for a correct conclusion supported by correct working. |

**Question 10 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | × *π* × 2*r* =  × *π* × 12  = 23.038… | P1 | This mark is given for a process to find the length of the major arc |
| = | P1 | This mark is given for a process to use the sine rule to find the distance *OD* |
| *OD* =  =  = 8.858… | P1 | This mark is given for finding the length *OD* |
| 23.038 + 14 + (8.858 – 6) = 39.896 | P1 | This mark is given for a complete process to find the perimeter |
| 39.9 (3 s.f.) | A1 | This mark is given for an answer to three significant figures in the range 39.8 to 40 |

**Question 11 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | π × 16  π × 49  π × 100 | 1 | This mark is given for process to find the area of any relevant circle |
| π × 72 – π × 42  = π × 33 | 1 | This mark is given for complete method to find the shaded area |
| π × 33 and π × 100 | 1 | This mark is given for for 2 comparable figures, |
| Daisy is wrong since it should be  which is ≠ | 1 | This mark is given for a correct statement supported by their figures |

**Question 12 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | (2*n* + 6)2  or  (*n* – 1)2  or  (*n* + 13)2 | P1 | This mark is given for a process to find the area of at least one of the circles in algebraic form |
| (2*n* + 6)2 – (*n* – 1)2 >(*n* + 13)2 | P1 | This mark is given for a process to set up an inequality in *n* |
| 4*n*2 + 24*n* + 36 – *n*2 + 2*n* – 1  > *n*2 + 26*n* + 169 | P1 | This mark is given for a process to remove all brackets |
| *n*2 > 67 | P1 | This mark is given for isolating the *n*2 term |
| 9 | A1 | This mark is given for the correct answer only |

**Question 13 (Total 5 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | × π × 302 (= 628.32…) | P1 | This mark is given for a process to find the area of sector *AOB* |
|  | × 302 × sin 80° (= 443.16...) | P1 | This mark is given for a process to find the area of triangle *AOB* |
|  | 628.32… – 443.16… (= 185.16…) | P1 | This mark is given for a process to process to find the area of the segment |
|  | × 100 | P1 | This mark is given for a process to find the area shaded as a percentage of the area of the circle |
|  | 6.55 | A1 | This mark is given for an answer in the range 6.5 – 6.6 |

**Question 14 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | Arc length = 25 – 9 – 9 = 7 | P1 | This mark is given for a process to find the arc length |
| =  = | P1 | This mark is given for a process linking the arc length to the circumference |
| *x* = | P1 | This mark is given for a complete process to find the value of *x* |
| = 44.6° | A1 | This mark is given for the correct answer only |

**Question 15 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | *OAB* = 90° ; *OCB* = 90° | 1 | This mark is given for identifying a right angle in the diagram |
| *AB* = *CB* = 10 × tan 60° = 10√3 | 1 | Thismark is given for finding the length of *AB* or *CB* |
| Area *OAC* =  × *π* × 102 = 104.72… | 1 | This mark is given finding the area of the sector |
| Area *OAB* = *OBC*  =  × 10 × 10√3 = 50√3 | 1 | This mark is given for finding the area of the right angled triangle *OAB* or *OBC* |
| Shaded area = area *OABC* – area *OAC*  = (2 × 50√3) – 104.72 = 68.5 | 1 | This mark is given for a correct answer in the range 68.4 – 68.6 |

**Question 16 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | × *π* × 102 × 10 (= )  or  × *π* × 102 × 5 (= ) | P1 | This mark is given for a process to find the volume of the shape. |
| 40π ÷  or 50*π* ÷ | P1 | This mark is given for a process to find the density of the shape. |
| 40*π* ×  (= 0.32)  **and** 50*π* ×  (= 0.6) oe | P1 | This mark is given for a complete process to find the densities. |
| or | P1 | This mark is given for a process to find percentage. |
| 87.5 | 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 averages**  **Marks of candidates who achieved grade:** | | | | | | | | | | | | |
| **Q** | **Series** | **Paper** | **ALL** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | | **1** | | **U** |
| **1** | 6 | Mock Set 4 | 2H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | |
| **2** | 5 | Mock Set 2 | 2H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | |
| **3** | 12 | June 2019 | 2H | 4 | Geometry | G18, R10 | 3 | 55 | 2.20 | 3.81 | 3.64 | 3.21 | 2.29 | 1.17 | 0.47 | 0.21 | - | - | | 0.13 | |
| **4** | 17 | June 2017 | 2H | 5 | Geometry | R9, G18 | 3 | 37 | 1.87 | 4.50 | 3.90 | 2.89 | 1.68 | 0.75 | 0.24 | 0.06 | - | - | | 0.03 | |
| **5** | 8 | June 2017 | 3H | 4 | Geometry | G17, G20 | 3 | 36 | 1.42 | 3.42 | 2.56 | 1.86 | 1.32 | 0.84 | 0.40 | 0.11 | - | - | | 0.02 | |
| **6a** | 9a | June 2019 | 2H | 2 | Ratio | R12 | 1 | 36 | 0.72 | 1.64 | 1.25 | 0.88 | 0.62 | 0.42 | 0.25 | 0.11 | - | - | | 0.06 | |
| **6b** | 9b | June 2019 | 2H | 2 | Ratio | R12 | 1 | 37 | 0.74 | 1.68 | 1.36 | 0.98 | 0.67 | 0.39 | 0.18 | 0.05 | - | - | | 0.02 | |
| **7** | 13 | Nov 2018 | 2H | 3 | Geometry | G17, G23 | 3 | 24 | 0.72 | 2.60 | 2.21 | 2.07 | 1.47 | 1.10 | 0.43 | 0.15 | - | - | | 0.04 | |
| **8** | 21 | June 2017 | 2H | 4 | Geometry | , G20, G16 | 3 | 19 | 0.74 | 1.98 | 1.16 | 0.85 | 0.68 | 0.50 | 0.31 | 0.15 | - | - | | 0.08 | |
| **9** | 7 | Nov 2018 | 1H | 4 | Geometry | N8, R3, G17, G18 | 2 | 17 | 0.67 | 3.80 | 3.27 | 2.66 | 1.64 | 0.92 | 0.25 | 0.05 | - | - | | 0.02 | |
| **10** | 16 | Nov 2018 | 3H | 5 | Ratio | G22, G18 | 3 | 12 | 0.58 | 4.80 | 4.50 | 2.79 | 1.57 | 0.61 | 0.08 | 0.01 | - | - | | 0.00 | |
| **11** | 4 | Nov 2017 | 1H | 4 | Geometry | N1, R3, G17 | 3 | 12 | 0.47 | 3.50 | 3.32 | 2.24 | 1.69 | 0.93 | 0.32 | 0.12 |  |  | | 0.02 | |
| **12** | 12 | Mock Set 3 | 1H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | |
| **13** | 15 | Mock Set 1 | 2H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | |
| **14** | 19 | Mock Set 3 | 2H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - |  | |  | |
| **15** | 20 | Nov 2017 | 2H | 5 | Geometry | G10 G16 G18 G20 | 3 | 5 | 0.26 | 3.38 | 2.65 | 1.59 | 0.96 | 0.43 | 0.15 | 0.04 |  |  | | 0.02 | |
| **16** | 19 | Mock Set 4 | 1H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | |
|  |  |  |  | **71** |  |  |  |  | **10.39** | **35.11** | **29.82** | **22.02** | **14.59** | **8.06** | **3.08** | **1.06** | **0** | **0** | | **0.44** | |