**GCSE Mathematics (1MA1)**

**Themed papers – Circle Theorems**

**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** |
| --- | --- | --- | --- |
|  | *BDA* =  = 70°  *BCD* = 180 – 70 = 110 | M1 | This mark is given for a method to find the angles *BDA* and *BCD* |
| Base angles at the base of an isosceles triangle are equal  Opposite angles of a cyclic quadrilateral add up to 180 | C1 | This mark is given for two appropriate reasons stated |
| *BDC* = 55 | M1 | This mark is given for a finding the angle *BDC* |
| Base angles at the base of an isosceles triangle are equal | C1 | This mark is given for a an appropriate reason stated |
| *ADE* = 180 – 55 ­– 70 = 75°  Angles on a straight line add up to 180° | A1 | This mark is given for correctly finding the angle *ADE* with an appropriate reason stated |

**Question 2 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *OAD* = 90 | B1 | This mark is given for a finding the size of the angle *OAD* |
| *AOB* = 90 + 32 = 122  *OAB* =  = 29 | M1 | This mark is given for a method to find the size of the angle *OAB* |
| *CAB* = 180 – 90 – 29 = 61 | A1 | This mark is given for the correct answer only |

**Question 3 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *BAO* = *x*  Base angles in an isosceles triangle are equal  *AOB* = 180 – 2*x*  Angles in a triangle add up to 180°  *OBC* = 90  A tangent to a circle is perpendicular to the radius | M1 | This mark is given for identifying at least one missing angle |
| 180 – *x – x* – 90  Angles in a triangle add up to 180° | M1 | This mark is given for a full method to find the required angle |
| 90 – 2*x* | A1 | This mark is given for the correct answer in its simplest form |
| Base angles in an isosceles triangle are equal, angles in a triangle add up to 180°, a tangent to a circle is perpendicular to the radius | C2 | These marks are given for a full set of reasons  (One mark is given for one correct reason included) |

**Question 4 (Total 4 marks) – Version 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) | *ODE* = 90 | M1 | This mark is given for a method to find one missing angle |
| The tangent *FDE* to the circle is perpendicular (90°) to the radius *OD* | C1 | This mark is given for a correct supporting reason |
| *BDE* = *y*  Alternate segment theorem  Thus *y* – *x* = 90 | A1 | This mark is given for a complete correct method leading to *y* – *x* = 90 with all correct reasons given |
| (b) | No; *y* must be less than 180 because it is an angle in a triangle. | C1 | This mark is given for a correct explanation |

**Question 4 (Total 4 marks) – Version 2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) | *DBO* = *x* | M1 | This mark is given for a method to find one missing angle |
| Base angles of an isosceles triangle are equal | C1 | This mark is given for a correct supporting reason |
| *BCD* = *BOD* = 90 – *x*  Angle at the centre is double the angle at the circumference  *y* + 90 – *x* = 180  Opposite angles in a cyclic quadrilateral are equal  Thus *y* – *x* = 90 | A1 | This mark is given for a complete correct method leading to *y* – *x* = 90 with all correct reasons given |
| (b) | No; *y* must be less than 180 because it is an angle in a triangle. | C1 | This mark is given for a correct explanation |

**Question 5 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *OAB* = 90 – 56  = 34 | C1 | This mark is given for a method to find angle *OAB* |
| *BOA* = 112  *BCA* = 56 | C1 | This mark is given for a method to find angle *CAD* (angle at the centre is twice that at the circumference) |
| *CAO* = 180 – 34 – 34 – 35 – 56  = 21 | C1 | This mark is given for the correct answer only |

**Question 6 (Total 4 marks) – Version 1**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *OAB* = 57°  Alternate segment theorem | M1 | This method mark is given for method to find *OAB* |
| *OBA* = 57°  Base angles of an isosceles triangle are equal  *AOB* = 66°  Angles in a triangle add up to 180° | M1 | This method mark is given for complete method to find *AOB* |
| 66° | C2 | These two communication marks are given for an answer of 66° with all reasons appropriate for their method  (C1 (dep on M1) for one appropriate circle theorem reason for their method) |

**Question 6 (Total 4 marks) – Version 2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *ODB* = 90° – 57° = 33°  The tangent to a circle is perpendicular (90°) to the radius (diameter) | M1 | This method mark is given for method to find *ODB* |
| *OBD* = 33°  Base angles of an isosceles triangle are equal  *DOB* = 114°  Angles in a triangle add up to 180°  *AOB* = 66°  Angles on a straight line add up to 180° | M1 | This method mark is given for complete method to find *AOB* |
| 66° | C2 | These two communication marks are given for an answer of 66° with all reasons appropriate for their method  (C1 (dep on M1) for one appropriate circle theorem reason for their method) |

**Question 6 (Total 4 marks) – Version 3**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *ODB* = 90° – 57° = 33°  The tangent to a circle is perpendicular (90°) to the radius (diameter) | M1 | This method mark is given for method to find *ODB* |
| *OBD* = 33°  Base angles of an isosceles triangle are equal  *AOB* = 66°  The exterior angle of a triangle is equal to the sum of the interior opposite angles | M1 | This method mark is given for complete method to find *AOB* |
| 66° | C2 | These two communication marks are given for an answer of 66° with all reasons appropriate for their method  (C1 (dep on M1) for one appropriate circle theorem reason for their method) |

**Question 7 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | *ACD* = 54°  or  *ADC* = 66° | M1 | This mark is given for finding the size of angle *ACD* or *ADC* |
| Alternate segment theorem  or  Opposite angles of a cyclic quadrilateral add up to 180 | C1 | This mark is given for a correct reason given for the angle found |
| *CAD* = 60° | A1 | This mark is given for finding the size of angle *CAD* = 60° |
| Angles in a triangle add up to 180 | C1 | This mark is given for a correct reason given for the angle found |

**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** | 18 | June 2019 | 2H | 5 | Geometry | G3, G4, G10 | 2 | 52 | 2.61 | 4.63 | 4.20 | 3.49 | 2.52 | 1.61 | 1.01 | 0.58 | - | - | 0.33 |
| **2** | 17 | Nov 2019 | 2H | 3 | Geometry | G3, G10 | 2 | 43 | 1.30 | 2.89 | 2.70 | 2.68 | 2.27 | 1.78 | 0.89 | 0.39 | - | - | 0.16 |
| **3** | 11 | June 2018 | 1H | 5 | Geometry | G10 | 2 | 29 | 1.45 | 4.11 | 3.10 | 2.04 | 1.20 | 0.63 | 0.29 | 0.12 | - | - | 0.07 |
| **4a** | 13a | June 2018 | 2H | 3 | Geometry | A21/G10 | 2 | 26 | 0.77 | 2.33 | 1.49 | 0.95 | 0.66 | 0.41 | 0.21 | 0.08 | - | - | 0.03 |
| **4b** | 13b | June 2018 | 2H | 1 | Geometry | G3 | 2 | 55 | 0.55 | 0.88 | 0.76 | 0.65 | 0.56 | 0.45 | 0.35 | 0.24 | - | - | 0.11 |
| **5** | 12 | Nov 2018 | 1H | 3 | Geometry | G3, G10 | 2 | 18 | 0.54 | 2.60 | 2.52 | 1.91 | 1.20 | 0.76 | 0.25 | 0.07 | - | - | 0.07 |
| **6** | 17 | Mock Set 1 | 1H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **7** | 20 | Mock Set 2 | 2H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **28** |  |  | **12** | **223** | **7.22** | **17.44** | **14.77** | **11.72** | **8.41** | **5.64** | **3** | **1.48** |  |  |  |