**GCSE Mathematics (1MA1)**

**Themed papers – Circle Theorems B**

**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 3 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | (angle) *BAE* = (angle) *CDE*  angles in the same segment are equal  or  angles at the circumference subtended on the same arc are equal | C1 | This mark is given for identifying one pair of equal angles with a correct reason |
| (angle) *AEB* = (angle) *DEC*  opposite angles or vertically opposite angles are equal | C1 | This mark is given for identifying a second pair of equal angles with a correct reason |
| Thus the two triangles have three pairs of equal angles and so are similar | C1 | This mark is given for a correct conclusion with supporting reasons |

**Question 2 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | ∠*ACB* = ∠*ADB* = 60°  Angles in the same segment are equal  ∠*DBC* = ∠*DAC* = 60°  Angles in the same segment are equal  Thus ∠*ACB* = ∠*DBC* = 60° | C1 | This mark is given for arguments to show that ∠*ACB* = ∠*ADB* and ∠*DBC* = ∠*DAC* with reasons given to show that ∠*ACB*= ∠*DBC* |
| ∠*ABC* = 60 + ∠*ABD* = 60 + ∠*ACD* = ∠*DCB*  Angles in the same segment are equal | C1 | This mark is given for an argument to show that ∠*ABC* = ∠*DCB* |
| *BC* is common to both triangles | C1 | This mark is given for finding a side common to both triangles |
| Thus triangles *ABC* and *DCB* are congruent (AAS) | C1 | This mark is given for a correct conclusion with reference to AAS |

**Question 3 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *x*  *x*  *y*  *y*  base angles of an isosceles triangle are equal | 1 | This mark is given for drawing the line *OC* to make an isosceles triangles *OBC* and *AOC* |
| *x* + *x* + *y* + *y* = 180°  angles in a triangle add up to 180 | 1 | This mark is given for finding the sum of the angles in triangle *ABC* |
| 2*x* + 2*y* = 2(*x* + *y*) = 180,  so *x* + *y* = angle *ACB* = 90° | 1 | This mark is given for a complete proof to show ACB = 90° |
|  | 1 | This mark is given for a complete proof with all reasons given |

**Question 4 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | If *CAB* = *x*, then *CRO* = 180 – *x*  Opposite angles of a cyclic quadrilateral add up to 180 | C1 | This mark is given for establishing a relationship between angles in a cyclic quadrilateral with a reason given |
| *ORB* = *x*  Angles on a straight line add up to 180 | C1 | This mark is given for finding the size of angle *ORB* with a reason given |
| *RO* = *OB* since both a radii of the same circle  *ABC* = *x*  Base angles of an isosceles triangle are equal | C1 | This mark is given for finding the size of angle *ABC* with a reason given |
| Thus ∠ *CAB* = ∠ *ABC* | C1 | This mark is given for a complete proof with all correct reasons given |

**Question 5 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *x*  *y*  angles at a point add up to 360°  *x* + *y* = 360° | C1 | This mark is given for drawing *AO* and *OC* and considering angles around the point *O* |
| The angle at the centre of a circle is twice the angle at the circumference  ∠*ABC* = *x* or ∠*ADC* = *y*    *x*  *y* | C1 | This mark is given for a correct use of “angle at centre...” to find angle *ABC* or angle *ADC* |
| ∠*ABC* + ∠*ADC* = *x* + *y*  = (*x* + *y*) = (360°) = 180° | C1 | This mark is given for a conclusion |
|  | C1 | This mark is given for a correct complete proof with all reasons given  NB: “opposite angles of a cyclic quadrilateral add up to 180°” is not acceptable |

**Question 6 (Total 6 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | eg *BCT* = *x* so *BCO* = 90 – *x*  **or** eg *OBC* = *OCB* | P1 | starts process by identifying *OCT* as 90°  or by use of isosceles triangle angle properties |
| eg if *BAC* = *y* then *BOC* = 2*y*  2*y* + 2*w* + 2(90 − *x*) = 180  or (*x* + *y*) + (*y* + *w*) + (*w* + *x*) = 180 | P1 | continues process by using another angle property  eg in triangle *ABC* forms an equation using the angles |
| eg *BAC*(*y*) = *BCT*(*x*) or *BAC* = *y* + *w* = 90 – *x* = *BCT* | C1 | complete process leading to establishment of a link between *BAC* and *BCT* |
| full proof with full appropriate reasons given for their method of proof eg using  The tangent to a circle is perpendicular to the radius (diameter) ;  The angle at the centre of a circle is twice the angle at the circumference ;  Angles in a triangle add up to 180 ;  Base angles of an isosceles triangle are equal. | C1 |  |

**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** | 15 | June 2017 | 2H | 3 | Geometry | G6 G10 | 2 | 20 | 0.60 | 1.91 | 1.21 | 0.76 | 0.47 | 0.27 | 0.12 | 0.04 | - | - | 0.01 |
| **2** | 22 | Nov 2019 | 1H | 4 | Geometry | G4 G5 G10 | 2 | 4 | 0.17 | 1.78 | 0.76 | 0.50 | 0.33 | 0.16 | 0.08 | 0.03 | - | - | 0.02 |
| **3** | 20 | Nov 2017 | 3H | 4 | Geometry | G10 | 2 | 1 | 0.03 | 2.75 | 0.82 | 0.08 | 0.08 | 0.03 | 0.01 | 0.00 |  |  | 0.00 |
| **4** | 21 | Nov 2018 | 2H | 4 | Geometry | G3, G9, G10 | 2 | 0 | 0.00 | 0.30 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | - | - | 0.00 |
| **5** | 21 | Mock Set 1 | 3H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **6** | 17 | Mock set 3 | 1H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **23** |  |  |  |  | 0.80 | 6.74 | 2.85 | 1.34 | 0.88 | 0.46 | 0.21 | 0.07 |  |  | 0.03 |