**GCSE Mathematics (1MA1)**

**Themed papers – Coordinate geometry: 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** |
| (a) |  | B1 | This mark is given for a circle with centre (0, 0) |
| B1 | This mark is given for a circle with a radius of 3.5 |
|  | M1 | This mark is given for the line 2*x* + *y* = 1 drawn |
| (b) | *x* = 2.0, *y* = –2.9*x* = –1.2, *y* = 3.3 | A1 | This mark is given for one correct pair of solutions for *x* and *y* |
| A1 | This mark is given for both correct pairs of solutions for *x* and *y*, unambiguously matched |

**Question 2 (Total 1mark)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | √42.25 = 6.5 | B1 | This mark is given for a correct answer only |

**Question 3 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | The curve cuts the *y* axis at *x* = 0 *y* = *ax* = *a*0 = 1(0, 1) | B1 | This mark is given for the correct answer only |
| (b) |  | M1 | This mark is given for any one of a circle with radius 4, centre (3, 0) or points (−1, 0) and (7, 0) labelled  |
|  | M1 | This mark is given for any further element of a circle with radius 4, centre (3, 0) or points (−1, 0) and (7, 0) labelled  |
| (–1, 0)(3, 0)(7, 0) | A1 | This mark is given for a fully correct sketch only: a circle with radius 4 and centre (3, 0) and with the points (−1, 0) and (7, 0) labelled |

**Question 4 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
| (a) | *OA* = 16 sin 30° = 8 | P1 | This mark is given for a process to find the length *OA* |
| *x*2 + *y*2 = 64 | P1 | This mark is for a process to use the equation of the circle *x*2 + *y*2 = *r*2 |
| 9*p*2 + *p*2 = 6410*p*2 = 64*p* = √6.4 | P1 | This mark is given for a process to substitute 3*p* and *p* into the equation for a circle to solve for *p* |
| 2.53 | A1 | This mark is given for a correct answer in the range 2.52 to 2.53 |

**Question 5 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | $$-1÷\frac{3}{4}=-\frac{4}{3}$$ | M1 | This mark is given for a method to find gradient of tangent |
| using *y =* "$-\frac{4}{3}$ "*x + c* | M1 | This mark is given for a method to find the *y*-intercept  |
| *y =* $-\frac{4}{3}$ *x +* $\frac{25}{3}$ | A1 | This mark is given for a correct answer or a correct equivalent |

**Question 6 (Total 5 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *x* = 10 + 2*y*(10 + 2*y*)2 + *y*2 = 20 | 1 | This mark is given for a method to start the process by finding a value for *x* in terms of *y* and substituting |
| (100 + 20*y* + 20*y* + 4*y*2) + *y*2 = 204*y*2 + 20*y* + 20*y* = 100 | 1 | This mark is given for expanding brackets on the expression obtained |
| 5*y*2 + 40*y* + 80 = 0 | 1 | This mark is given for forming a quadratic equation to be solved |
| (5*y* + 20) (*y* + 4) = 0*y* = –4, *x* = 2 | 1 | This mark is given for solving the quadratic equation for *y* and so find the value of *x* |
| The line intersects the circle at only one point (2, –4), so must be a tangent | 1 | This mark is given for a fully correct statement to conclude the proof |

**Question 7 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *AB* = *BC* | P1 | This mark is given for recognising that the lines *AB* and *BC* are equal in length |
| *E**D**x*2 + *y*2 = 100 so *OC* = 10Using Pythagoras’ theorem,*CD* = 8, *DE* = 10, *OD* = 6 | P1 | This mark is given for a start to the process to find the length of the tangent *AB* or *BC* |
| Let length *AB* = length *CB* = *x**AE* = *OD* = 6, *EB* = *x* – 6, *CE* = 18Using Pythagoras, *CB*2 = *EC*2 + *EB*2*x*2 = 182 + (*x* – 6)2*x*2 = 324 + *x*2 – 12*x* + 36 –12*x* + 360 = 0*x* = 30 | P1 | This mark is given for a complete process to find the length of the tangent *AB* or *BC* |
| Area of *ABCO* = area of triangle *OCB* + area of triangle *OAB*= 2 ×  × 30 × 10 = 300 | A1 | This mark is given for the correct answer only |

**Question 8 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | draw diagram and find gradient of *OA* (= 3) | P1 | This mark is given for a process to start the problem |
|  | P1 | This mark is given for a process to find equation of tangent with *m*= –1/‘3’ |
|  | P1 | This mark is given for a process to find x-axis intercept of tangent |
|  | P1 | This mark is given for a process to find area of triangle  |
| 60 | A1 | This mark is given for a correct answer only |

**Question 9 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | Gradient  =  ÷  =  | M1 | This mark is given for a method to find gradient of *OP* |
|  × *m* = –1, so *m* =   | M1 | This mark is given for a method to find gradient *m* of the tangent to *OP*  |
| Gradient of tangent to *OP*, *y* = *x* + *c* =  ×  + *c*so *c* =  +  =  = Thus equation of the tangent to **L** is *y* = *x* +  | 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 | 16a | June 2018 | 2H | 2 | Algebra | A16 | 2 | 41 | 0.81 | 1.92 | 1.74 | 1.30 | 0.74 | 0.29 | 0.11 | 0.05 | - | - | 0.03 |
| 1b | 16b | June 2018 | 2H | 3 | Algebra | A19 | 2 | 19 | 0.58 | 2.48 | 1.67 | 0.79 | 0.27 | 0.07 | 0.02 | 0.01 | - | - | 0.00 |
| 2 | 15 | Nov 2018 | 2H | 1 | Algebra | A16 | 1 | 30 | 0.3 | 1 | 0.94 | 0.81 | 0.65 | 0.42 | 0.2 | 0.08 | - | - | 0.01 |
| 3a | 20a | June 2017 | 3H | 1 | Algebra | A14 | 1 | 20 | 0.2 | 0.81 | 0.49 | 0.22 | 0.1 | 0.05 | 0.03 | 0.03 | - | - | 0.03 |
| 3b | 20b | June 2017 | 3H | 3 | Algebra | A13 | 2 | 25 | 0.76 | 2.66 | 2.01 | 1.1 | 0.44 | 0.14 | 0.04 | 0.02 | - | - | 0.01 |
| 4 | 22 | June 2019 | 3H | 4 | Algebra | A16, G10, G20 | 3 | 11 | 0.42 | 2.12 | 0.9 | 0.45 | 0.21 | 0.08 | 0.03 | 0.01 | - | - | 0 |
| 5 | 23 | June 2017 | 2H | 3 | Algebra | A16 | 2 | 9 | 0.26 | 1.89 | 0.73 | 0.18 | 0.04 | 0.01 | 0 | 0 | - | - | 0 |
| 6 | 19 | Nov 2017 | 3H | 5 | Algebra | A19 A16 | 1 | 2 | 0.12 | 4.62 | 1.88 | 1.08 | 0.34 | 0.19 | 0.03 | 0.01 |  |  | 0 |
| 7 | 21 | Mock Set 4  | 1H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | 22 | Spec Set 2  | 1H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | 23 | Spec Set 1  | 2H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **34** |  |  |  |  | **3.45** | **17.5** | **10.36** | **5.93** | **2.79** | **1.25** | **0.46** | **0.21** | **-** | **-** | **0.08** |