**GCSE Mathematics (1MA1)**

**Themed papers – Trigonometry 2D and Bearings**

**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 2 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *AB* = sin 38° × 16*AB* = 0.61566 × 16 | M1 | This mark is given for a method to find the length of *AB* |
| 9.85 | A1 | This mark is given for the correct answer only |

**Question 2 (Total 2 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  |  = 2.5,  = 2.5,  = 2.5 | M1 | This mark is given for a method to divide at least a pair of corresponding sides |
| All sides are enlarged by the same factor, so triangles are similar | C1 | This mark is given for a correct comment |

**Question 3 (Total 2 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | 16² = 6.7² + *a*² **or** $\sqrt{16²-6.7²}$ | M1 | This mark is given for substituting into Pythagras’ theorem |
|  | M1 | This mark is for a complete method to find the unknown length |
| 14.5 to 14.53 | A1 | This mark is given for an answer in the range of 14.5 to 14.53 |

**Question 4 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | cos *ABC* =  = 0.6363… | M1 | This mark is given for a method to find a value for the cosine of the angle *ABC* |
| 50.5 | A1 | This mark is given for the correct answer only (using a calculator) |
| (b) | The value of cos *ABC* increases as the size of the angle decreases | C1 | This mark is given for a correct statement with a supporting reason |

**Question 5 (Total 2 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | sin 30° =  $\frac{x}{18}$or *x* = 18 ×$ ×$ sin 30° | M1 | This mark is given for a method to find out a value for *x*  |
| sin 30° = 0.5, so *x* = 9 | A1 | This mark is given for the correct answer only |

**Question 6 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | tan *QPR* =  | P1 | This mark is given for a process to link 60% to a trigonometric ratio |
| ∠ *QPR* = 30.96° | P1 | This mark is given for a method to find the size of angle *QPR* |
| sin *QPR* = 0.514 | A1 | This mark is given for the correct answer only |

**Question 7 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  =  | P1 | This mark is given for using the sine rule as a start of the process to find the length *BD* |
| *BD* =  × sin 34° = 7.39 | P1 | This mark is given for a complete process to find the length *BD* |
| *AD*2 = 11.42 + 7.392 – (2 × 11.4 × 7.39 × cos 86°) | P1 | This mark is given for using the cosine rule as a start of the process to find the length *AD* |
| *AD*2 = 129.96 + 54.6 – 11.75 = 172.85 | P1 | This mark is given for a complete process to find the length *AD* |
| *AD* = 13.1 | A1 | This mark is given for the correct answer only |

**Question 8 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  = 18*A* = 2 × 18 = 36°*B* = 3 × 18 = 54° | P1 | This mark is given for a process to find values for angles *A* and *B* |
| cos 36° = 0.809 | P1 | This mark is given for writing a value for cos *A* |
| *AB* =  =  | P1 | This mark is given for a process to find the length *AB* |
| 17.3 | A1 | This mark is given for the correct answer in the range 17.3 to 17.4 |

**Question 9 (Total 3 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | 1 | B1 | This mark is given for the correct answer only |
| (b) | cos 60° = 0.5 = , *x* =  | M1 | This mark is given for a method to find the value of *x* |
| 8 | A1 | This mark is given for the correct answer only |

**Question 10 (Total 5 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | (*x* + 3)(2*x* – 1) sin 45 = 6√2 | P1 | This mark is given for setting up an expression for the area in the form *ab* sin *C* |
| (2*x*2 – 5*x* +3) sin 45 = 6√2 | P1 | This mark is given for expanding the brackets in the expression to form an equation |
| (2*x*2 – 5*x* +3)  = 6√22*x*2 – 5*x* + 3 = 24 | P1 | This mark is given for a process to set up the equation and rearrange to the form *ax*2+ *bx* + *c* + *d*  |
| 2*x*2 – 5*x* – 27 = 0*x* =  | P1 | This mark is given for a substitution into the quadratic formula |
| 2.63 | A1 | This mark is given for the correct answer only  |

**Question 11 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | sin 40° = *DB* = 8.6 sin 40° = 5.528 | P1 | This mark is given for a process to find the length *DB* |
| *ED* =  = 2.764 | P1 | This mark is given for a process to find the length *ED* |
| ∠ *EAD* = tan–1 | P1 | This mark is given for a process to find the angle *EAD* |
| ∠ *EAD* = 32.1 | A1 | This mark is given for the correct answer given to 1 decimal place |

**Question 12 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | 7.52 – 62  | 1 | This mark is given for a method to find the third length of the right angled triangle shown |
| 7.52 – 62 = 56.25 – 36 = 20.25√20.25 = 4.5 | 1 | This mark is given for finding the third length of the right angled triangle shown |
| 24 – 4.5 – 10 = 9.5 | 1 | This mark is given for finding a length for a right angled triangle to be able to calculate angle *CDA* |
| tan *CDA* =  | 1 | This mark is given for finding the tangent of the angle *CDA* |
| angle *CDA* = 32.3° | 1 | This mark is given for an answer in the range 32.2–32.3 |

**Question 13 (Total 4 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | 4.52 + 72 | P1 | This mark is given for a process using Pythagoras to find the length *KM* |
| √(4.52 + 72) = √69.25 = 8.32… | P1 | This mark is given for finding the length *KM* |
| sin *KLM* =  = 0.55477… | P1 | This mark is given for a process to find the sine of angle *KLM* |
| ∠ *KLM* = 33.7 | A1 | This mark is given for the correct answer only |

**Question 14 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  =  | P1 | This mark is given for a process to derive an equation in *x* |
| (4*x* ­– 1)(6*x* + 5) = *x*(12*x* + 31) | P1 | This mark is given for a process to remove fractions from the equation |
| 24*x*2 + 14*x* – 5 = 12*x*2 + 31*x*24*x*2 + 14*x* – 5 – 12*x*2 – 31*x* = 012*x*2 – 17*x* – 5 = 0 | P1 | This mark is given for a process to form a quadratic equation |
| (4*x* + 1)(3*x* – 5) = 0or­ =  | P1 | This mark is given for a process to solve the quadratic equation, either by factorising or by using the quadratic formula |
| *x* =  (rejecting *x* = –) | A1 | This mark is given for the correct answer only |

**Question 15 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  | P1 | This mark is given for a start to the process using the sine rule |
| = 38.1 | P1 |  |
| *BDC* = 180 – 70 – 74 = 36 | P1 |  |
| 0.5 × 52 × 38.1 × sin“36” | P1 |  |
| 583 | A1 | This mark is given for an answer in the range of 582 to 583 |

**Question 16 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | *CD*2 = 4.92+3.82– 2×4.9×3.8×cos80 = 31.98 | P1 | This mark is for a start to the process by using cosine rule to find *CD* |
|  or  | P1 | This mark is for using the sine rule to find angle *ACD* or angle *ADC* |
|  | P1 | This mark is for using the sine rule to find *BC* or *BD* |
| 1/2 *ab*sin*C* | P1 | This mark is for a process to find area |
| 10.4 to 10.43 | A1 | This mark is given for an answer in the range of 10.4 to 10.43 |

**Question 17 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | Area of triangle *ADC* = *ab* sin *C* = 0.5 × 11 × (*CD* × sin 105°) = 56 | 1 | This mark is given for finding an equation for the area of triangle *ADC* |
| *CD* =  =  = 10.54 | 1 | This mark is given for finding the length of *CD* |
| *AC* 2 = 112 + (10.54)2 – 2 × 11 × 10.54 × cos 105° = 232.0916 + 60.01496= 292.10656*AC* = 17.091125 | 1 | This mark is given for using the cosine rule *c*2 = *a*2 + *b*2 – 2*ab* cos *C* to find the length of *AC* |
|  =  = *AB* =  | 1 | This mark is given for a method to us the sine rule to find the length of *AB* |
| 14.38 | 1 | This mark is given for an answer in the range 14.3 – 14.4 |

**Question 18 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | 0.5 × *7* × *BC* × sin 70° = 42 | P1 | This mark is given for a process to make a correct substitution into *ab* sin *C* |
| *BC* =  (= 12.77013327) | P1 | This mark is given for a process to rearrange to find the length *BC* |
| *AB*2 = *BC*2 + 7 2 – (2 × *BC* × 7 × cos 70°) | P1 | This mark is given for a process to us the cosine rule to find the length *AB* |
| *AB*2 = 163.0763 + 49 – (14 × 12.770 × 0.342) =150.9 | P1 | This mark is given for a process to find a value for *AB*2 |
| *AB* = √150.9 = 12.3 | A1 | This mark is given for an answer in the range 12.28 – 12.3 |

**Question 19 (Total 53 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | Shown on diagram |  | This mark is given for identifying the angle of 70o |
| eg. for process to find angle *BAC*, eg. (180 – 50) ÷ 2 (= 65o) |  | This mark is given for a process to find an angle in triangle *ABC,* |
| 135 |  | This mark is given for a correct answer only |

**Question 20 (Total 5 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working an or answer examiner might expect to see** | **Mark** | **Notes** |
|  | *ABC* = 360° – 150° – 143° = 67° | P1 | This mark is given for a process to find the angle *ABC* |
| *AC* 2  = 92 + 82 – 2 × 9 × 8 × cos 67° *AC*2 = 88.734… | P1 | This mark is given for a process to use the cosine rule *AC* 2 = *AB* 2 + *BC* 2 – 2 × *AB* × *BC* cos *ABC*to find *AC* |
| *AC* = 9.412 | P1 | This mark is given for correctly finding the distance *AC* |
|  = sin *BAC* =  = 0.8802*BAC* = 61.6° | P1 | This mark is given for a process to use the sine rule to find the angle *BAC* |
| 37 + 62. 6 = 098.6 | A1 | This mark is given for a correct answer in the range 098.5 to 098.6 |

**Question 21 (Total 5 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
|  | 3.42 = 6.12 + 6.22 – (2 × 6.1 × 6.2 × cos *C*) | B1 | This mark is given for the correct use of the cosine rule *c*2 = *a*2 + *b*2 cos *C* |
| 11.56 = 37.21 + 38.44 – (75.64 × cos *C*)cos *C* =  = 0.8473…*∠ BCA*  = 32.08° | P1 | This mark is given for a process to find the value of ∠ *BCA* |
|  =  =  | P1 | This mark is given for a correct substitution using the sine rule |
| *DC* =  | P1 | This mark is given for a process to find the length *DC* |
| 1.95 | A1 | This mark is given for a correct answer only (to 3 significant figures) |

**Question 22 (Total 2 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  | cos 30° =  | B1 | This mark is given for a correct statement about the value of cos 30° (seen anywhere) |
| *PQ* 2 = 102 + 102 – 2 × 10 × 10 × cos *PBQ* **=** 200 – 200 cos *PBQ* | M1 | This mark is given for applying the cosine rule to find an expression for *PQ* 2 |
| *AC* 2 = *x*2 + *x*2 – 2 × *x* × *x* × cos 30° = 2*x*2 – 2*x*2  = 2*x*2(1 – ) = (2 – √3)*x*2 | M1 | This mark is given for applying the cosine rule to find an expression for *AC* 2 |
| cos *PBQ* =  = 1 –  | M1 | This mark is given for rearranging to find an expression for cos *PBQ* |
| cos *PBQ* = 1 –  = 1 –  = 1 – *x*2 | A1 | This mark is given for a conclusion of proof with all working seen |

**Question 23 (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 |

**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** |
| 1 | 5 | June 2019 | 2H | 2 | Geometry | G20 | 1 | 83 | 1.65 | 1.97 | 1.95 | 1.9 | 1.78 | 1.5 | 1.06 | 0.53 | - | - | 0.22 |
| 2 | 7 | June 2017 | 3H | 2 | Geometry | G20 | 1 | 77 | 1.54 | 1.97 | 1.92 | 1.85 | 1.69 | 1.4 | 0.93 | 0.4 | - | - | 0.12 |
| 3 | 3 | Mock set 4 | 2H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4a | 5a | June 2018 | 3H | 2 | Geometry | G20 | 1 | 76 | 1.52 | 1.98 | 1.93 | 1.85 | 1.65 | 1.37 | 0.98 | 0.58 | - | - | 0.23 |
| 4b | 5b | June 2018 | 3H | 1 | Geometry | G20 | 2 | 9 | 0.09 | 0.29 | 0.15 | 0.1 | 0.07 | 0.05 | 0.04 | 0.02 | - | - | 0.01 |
| 5 | 6 | Mock Set 2 | 3H | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | 12 | Mock Set 3 | 2H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | 17 | June 2018 | 3H | 5 | Geometry | G20, G22, | 1 | 42 | 2.1 | 4.82 | 4.35 | 3.39 | 2.03 | 0.82 | 0.23 | 0.06 | - | - | 0.01 |
| 8 | 6 | Nov 2018 | 3H | 4 | Geometry | R5, G20 | 3 | 31 | 1.23 | 3.7 | 3.97 | 3.54 | 2.9 | 2.01 | 0.61 | 0.12 | - | - | 0.05 |
| 9a | 8a | Nov 2018 | 1H | 1 | Geometry | G21 | 1 | 19 | 0.19 | 1 | 0.82 | 0.56 | 0.38 | 0.22 | 0.11 | 0.08 | - | - | 0.04 |
| 9b | 8b | Nov 2018 | 1H | 2 | Geometry | G20 | 1 | 32 | 0.64 | 2 | 1.88 | 1.66 | 1.34 | 0.92 | 0.43 | 0.16 | - | - | 0.1 |
| 10 | 15 | June 2017 | 3H | 5 | Algebra | A18/G23 | 3 | 26 | 1.32 | 4.43 | 3.28 | 1.94 | 0.91 | 0.28 | 0.05 | 0 | - | - | 0 |
| 11 | 12 | Nov 2019 | 2H | 4 | Geometry | G20 | 3 | 25 | 1.01 | 3.44 | 3.35 | 2.87 | 2.24 | 1.2 | 0.49 | 0.11 | - | - | 0.02 |
| 12 | 7 | Nov 2017 | 2H | 2 | Geometry | G17 G20 | 3 | 21 | 1.04 | 5 | 4.03 | 3.86 | 2.98 | 2.15 | 0.99 | 0.31 | - | - | 0.05 |
| 13 | 6 | Mock Set 3 | 3H | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | 19 | June 2018 | 3H | 5 | Algebra | A18,A21,G20,R12 | 3 | 18 | 0.92 | 4.27 | 2.64 | 1.15 | 0.4 | 0.11 | 0.03 | 0.01 | - | - | 0 |
| 15 | 15 | Mock set 4 | 3H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | 21 | Spec Set 2 | 3H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | 17 | Nov 2017 | 3H | 5 | Geometry | G22 G23 | 3 | 3 | 0.15 | 4.5 | 3.09 | 1.32 | 0.59 | 0.21 | 0.02 | 0 | - | - | 0 |
| 18 | 24 | Mock Set 2 | 2H | 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | 9 | Spec Set 1 | 2H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | 23 | June 2019 | 3H | 5 | Geometry | G15, G20, G22 | 3 | 17 | 0.86 | 3.74 | 2.15 | 0.98 | 0.38 | 0.15 | 0.06 | 0.02 | - | - | 0.01 |
| 21 | 18 | Nov 2019 | 3H | 5 | Geometry | N12, G22 | 3 | 6 | 0.28 | 4.11 | 2.78 | 1.25 | 0.64 | 0.13 | 0.03 | 0 | - | - | 0 |
| 22 | 22 | June 2017 | 1H | 5 | Algebra | A4/G21/G22 | 2 | 4 | 0.18 | 1.12 | 0.39 | 0.18 | 0.08 | 0.03 | 0.01 | 0 | - | - | 0 |
| 23 | 19 | Mock Set 3  | 2H | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
|  |  |  |  | **88** |  |  |  |  | **14.72** | **48.34** | **38.68** | **28.4** | **20.06** | **12.55** | **6.07** | **2.4** | **-** | **-** | **0.86** |