**GCE AS Mathematics (8MA0) – Paper 1**

**Pure Mathematics 1**

**October 2020 student-friendly mark scheme**

**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.**

**This document is intended for guidance only and may differ significantly from the final mark scheme published in December 2020.**

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| **Guidance on the use of codes within this document** |
| 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.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.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)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
|  |  = 6*x*2 – 4 | M11.1b | This mark is given for a method to differentiate *x*3 to *x*2 |
| A11.1b | This mark is given for the correct answer only |
| When *x* = 2, 6*x*2 – 4 = 20 | M11.1b | This mark is given for a method substitute *x* = 2 into 6*x*2 – 4 |
| *y* – 13 = 20(*x* – 2) | M11.1b | This mark is given for a method to find a tangent at *P*(2, 13) |
| *y* = 20*x* – 27 | A11.1b | This mark is given for a correct answer only |

**Question 2 (Total 6 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | tan *θ* =  =  | M11.1b | This mark is given for a method to find an allowable angle |
| *θ* = 66.8°bearing = 180 + 66.8 | M13.1b | This mark is given for a method to find a bearing |
| 246.8° | A11.1b | This mark is given for a correct answer only (to one decimal place) |
| (b) | Distance =  = √58 | M11.1b | This mark is given for a method to find the distance travelled |
| Speed =  | M13.1b | This mark is given for a method to find the speed |
| 2.77 kmh–1 | A11.1b | This mark is given for a correct answer only (to one decimal place or 3 sf) |

**Question 3 (Total 6 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (i) | *x*√2 – √18 *x*(√2 – 1) = √18*x* =  | M11.1b | This mark is given for a method to find an expression for *x* in surd form |
| *x* =  × *x* = √18 (√2 + 1) | M13.1a | This mark is given for a method to simplify an expression for *x* by multiplying both numerator and denominator by an appropriate term |
| *x* = 6 + 3√2 | A11.1b | This mark is given for a correct answer only |
| (ii) | 26*x* – 4 =  | M12.5 | This mark is given for a method to set both sides of the equation as powers of 2 |
| 6*x* – 4 = – | M11.1b | This mark is given for complete method to find *x* |
| *x* =  | A11.1b | This mark is given for the correct answer only |

**Question 4 (Total 6 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | *A* = *mn* + *c*190 = 0*n* + *c* or 169 = 8*m* + *c*  | M13.3 | This mark is given for finding an equation in the form A = *mn* + *c* using (0, 190) or (8, 169) |
| *m* =  = –2.625 | M13.1b | This mark is given for a method to find the gradient |
| *A* = –2.625*n* + 190 | A11.1b | This mark is given for a correct answer only |
| (b) | *A* = (–2.625 × 19) + 190 | M13.4 | This mark is given for using *n* = 19 in an equation for *A* |
| *A* = 140.125 g km–1 | A11.1b | This mark is given for a correct answer only |
| The model predicts a much higher value and so is not suitable | B13.5a | This mark is given for a correct comment on the suitability of the model |

**Question 5 (Total 6 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) |  =  | M11.1b | This mark is given for a method to find *θ* using the sine rule |
| *θ* = 51.1° or 128.9° | A11.1b | This mark is given for a method to find ∠*ACB* |
| *θ* = 128.9° | A11.1b | This mark is given for a correct answer only (i.e. rejects 51.1°) |
| (b) | *AD*2 = 72 + 122 – 2 × 12 × 7 cos 101.9*AD* = 15.09 | M11.1b | This mark is given for a method to use the cosine rule to find the length *AD* |
| 12 + 7 + 7 + 15.09 = 41.09 | M13.1a | This mark is given for a method to find the total length of the structure |
| 42 m | A13.2a | This mark is given for rounding up the answer to find the total length of the steel beams bought |

**Question 6 (Total 6 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | (1 + *kx*)10 = 1 + 10*kx* + (*kx*)2 + (*kx*)3 | M11.1b | This mark is given for a method to produce a binomial expansion |
| A11.1b | This mark is given for a correct unsimplified binomial expansion |
| = 1 + 10*kx* + 45*k*2*x*2 + 120*k*3*x*3 +… | A11.1b | This mark is given for a correct answer only |
| (b) | 120*k*3 = 3 × 10*k* | M11.2 | This mark is given for the first step of a method to find *k* |
| 4*k*2 = 1 | M11.1b | This mark is given for a step to solving the cubic by cancelling *k* |
| *k* = ± | A11.1b | This mark is given for the correct answer only |

**Question 7 (Total 8 marks)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | 5√*x* + 3*x* | M11.1b | This mark is given for a method to integrate, i.e.  to  |
| A11.1b | This mark is given for a correct integration |
|  d*x* = 4 ⇒ 5√*k* + 3*k* – 8 = 4 | M11.1b | This mark is given for using limits and setting the equation equal to 4 |
| 3*k* + 5√*k* – 12 = 0 | A12.1 | This mark is given for a fully correct explanation using correct notation |
| (b) | 3*k* + 5√*k* – 12 = 0 ⇒ (3√*k*  – 4)(√*k* + 3) = 0 | M13.1a | This mark is given for factorising to solve the quadratic equation |
| √*k* = , –3 | A11.1b | This mark is given for finding two values of *k* |
| *k* =  only | M11.1b | This mark is given for solving and rejecting √–3 |
| A12.3 | This mark is given for a correct answer only |

**Question 8 (Total 9 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | When t = 0, temperature = 18 + 65 = 83 °C | B13.4 | This mark is given for using the model to find the temperature at *t* = 0 |
| (b) | 18 + 65 = 35 =  | M11.1b | This mark is given for a method to find *t*when *θ* = 35 |
| *t* = –8 ln  | M11.1b | This mark is given for taking lns to find a value for *t* |
| *t* = 10.7 | M11.1b | This mark is given for a correct answer only |
| (c) | As *t* → ∞, *θ*  → 18Minimum temperature is 18 °C | B12.4 | This mark is given for stating a valid explanation  |
| (d) | *A* + *B* = 94*A* + *B*e–1 = 50 | M13.4 | This mark is given for finding one of the equations in terms of *A* and *B* |
| A11.1b | This mark is given for finding both of the equations in terms of *A* and *B* correctly |
| *A*(e – 1) = 50e – 94 | M12.1 | This mark is given for a method to find the value of *A* |
| *μ* =  | A12.2a | This mark is given for a correct answer only (accept *μ* = 24.4) |

**Question 9 (Total 8 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) | *c* = –180°, *d* = –3 | B11.1b | This mark is given for finding *P*(–180°, –3) |
| (b) (i) | (–180 × 4, –3) = (–720°, –3) | B12.2a | This mark is given for the correct answer only |
| (b)(ii) | (–180 + 36, –3) = (–144°, –3) | B12.2a | This mark is given for the correct answer only |
| (c) | 3 cos *θ* = 8 tan *θ* ⇒ 3 cos2 *θ* = 8 sin *θ* | M13.1a | This mark is given for a method using tan *θ* to find sin *θ* |
| 3 (1 – sin2 *θ*) = 8 sin *θ* 3 – 3 sin2 *θ* – 8 sin *θ* = 03 sin2 *θ* + 8 sin *θ* – 3 = 0 | M11.1b | This mark is given for a method using sin2 *θ* + cos2 *θ* = 1 to find sin *θ* |
| (3 sin *θ* – 1)(sin *θ* + 3) = 0 | M11.1b | This mark is given for a method to factorise the quadratic equation |
| sin *θ* =  | A12.2a | This mark is given for finding a correct value for sin *θ* |
| 520.5° | A12.1 | This mark is given for a correct solution within the range 450 ≤ *θ* < 720 |

**Question 10 (Total 10 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) | g(5) = 2 × 53 + 52 – 41 × 5 – 70 = 0 | M11.1a | This mark is given for a method to find g(5) |
| g(5) = 0 ⇒ (*x* – 5) is a factorHence g(*x*) is divisible by (*x* – 5) | A12.4 | This mark is given for a correct reason and conclusion |
| (b) | 2*x*3 + *x*2 – 41*x* – 70 = (*x* – 5)(2*x*2 + 11*x* + 14) | M11.1b | This mark is given for a method to find the quadratic factor of g(*x*) |
| A11.1b | This mark is given for a correct answer only |
| g(*x*) = (*x* – 5)(2*x* + 7)(*x* + 2) | M11.1b | This mark is given for a method to factorise (2*x*2 + 11*x* + 14) |
| A11.1b | This mark is given for a correct answer only |
| (c) | = *x*4 + *x*3 – *x*2 – 70*x* | M11.1b | This mark is given for a method to integrate |
| A11.1b | This mark is given for a correct integration |
| = – –  | M12.2a | This mark is given for a method to integrate g(*x*) with limits 5 and –2 |
| 571 | A12.1 | This mark is given for a correct answer only |

**Question 11 (Total 9 marks)**

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| --- | --- | --- | --- |
| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (i) | *x*2 + *y*2 + 18*x* – 2*y* + 30 = 0 (*x* + 9)2 + (*y* – 1)2 = … | M11.1b | This mark is given for a method to use (*x* + 9)2 + (*y* – 1)2 = … |
| Centre of *C*1 is (–9, 1) | A11.1b | This mark is given for finding the coordinates of the centre of *C*1 |
|  =  | M11.1b | This mark is given for a method to find the gradient of the line from *P* to the centre of *C*1 |
| *y* – 7 = –(*x* + 5) | M13.1a | This mark is given for finding an equation of the tangent |
| 3*y* – 21 = –2*x* – 102*x* + 3*y* – 11 = 0 | A11.1b | This mark is given for finding an equation of *l* in the form *ax* + *by* + *c* = 0 |
| (ii) | *x*2 + *y*2 –8*x* + 12*y* + *k* = 0⇒ (*x* – 4)2 + (*y* + 6)2 = 52 – *k* | M11.1b | This mark is given for a method to use (*x* – 4)2 + (*y* + 6)2 = *P* – *k*, where *P* is a positive constant |
| *C*2 lies in quadrant 4 if radius < 4⇒ 52 – *k* < 42 | M13.1a | This mark is given for deducing that *C*2 lies entirely in quadrant 4 if its radius is less than 4 |
| *k* > 36 | A11.1b | This mark is given for a correct inequality for *k* |
| 52 – *k* > 0 so36 < *k* < 52 | A13.2a | This mark is given for rigorous working leading to a full solution |

**Question 12 (Total 7 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) | log10 *V* = 0.072*t* + 2.379 *V* = 100.072*t* + 2.379 | M11.1b | This mark is given for a method to use indices and make *V* the subject of the equation |
|  *V* = 100.072*t*× 102.379 | A11.1b | This mark is given for using the laws of indices to find the values of *a* and *b* |
|  *a* = 102.379 *b* = 100.072 | M12.1 | This mark is given for a method to identify the values of *a* and *b* |
|  *V* = 239 × 1.18*t* | A11.1b | This mark is given for a correct answer only (*a* = 239 and *b* = 1.18) |
| (b) | The value of *ab* is the total number of views one day after the advert was visible | B13.4 | This mark is given for a valid interpretation of the value of *ab* |
| (c) | When *t* = 20, *V* = 239 × 1.1820 | M13.4 | This mark is given for a method to substitute *t* = 20 into the equation for *V* |
| *V* = 6547 | A11.1b | This mark is given for a correct answer only (anything which rounds to 6500 or 6600) |

**Question 13 (Total 5 marks)**

| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| --- | --- | --- | --- |
| (a) | (2*a* – *b*)2 ≥ 0 | M11.1a | This mark is given for stating that (2*a* – *b*)2 ≥ 0 |
| 4*a*2 + *b*2 – 4*ab* ≥ 04*a*2 + *b*2 ≥ 4*ab* | A11.1b | This mark is given for multiplying out (2*a* – *b*)2 |
| Since *a* > 0 and *b* > 0 +  ≥  | M12.2a | This mark is given for a method to divide through by *ab* (maintaining the inequality) |
| Hence  +  ≥ 4 | A11.1b | This mark is given for a fully correct proof |
| (b) | For example:*a* = 5, *b* = –1⇒  +  = –20 –  < 4 | B12.4 | This mark is given for choosing a negative number and providing a counterexample |

**Question 14 (Total 9 marks)**

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| **Part** | **Working or answer an examiner might expect to see** | **Mark** | **Notes** |
| (a) | g(*x*) = *ax*3 + *bx*2 + *ax* | B12.2a | This mark is given for deducing g(*x*) = *ax*3 + *bx*2 + *ax* |
| When *x* = 2, 8*a* + 4*b* + 2*a* = 9 ⇒ 10*a* + 4*b* = 9 | M12.1 | This mark is given for a method to use *x*= 2 and *y* = 9 to produce an equation in *a* and *b* |
| A11.1b | This mark is given for a simplified equation in *a* and *b* |
| g′(2) = 0 ⇒ 12*a* + 4*b* + *a* = 0 13*a* + 4*b* = 0 | M12.1 | This mark is given for a method to differentiate g(*x*) and calculate g′(2) |
| A11.1b | This mark is given for a simplified equation in *a* and *b* |
| 10*a* + 4*b* = 913*a* + 4*b* = 03*a* = –9, *a* = –330 + 4*b* = 9, *b* =  | M11.1b | This mark is given for a method to solve simultaneous equations to find values for *a* and *b* |
| g(*x*) = –3*x*3 + *x*2 – 3*x* | A11.1b | This mark is given for a correct answer only |
| (b) | g″(*x*) = –18*x* +  | M11.1b | This mark is given for a method to differentiate g′(*x*) and substitute *x* = 2 |
| g″(2) = – g″(2) < 0, hence maximum | A12.4 | This mark is given for a correct conclusion |