| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |  | M1 A1 |
| Puts to give  | A1 \* |
|  |  |  **(3)** |
| **1(b)** |  |  | B1 |
| Shape of  | B1 |
|  cuts y axis at (0, –3) | B1 |
|  has asymptote at  | B1 |
|  |  |  **(4)** |
| **1(c)** | Only one crossing point | B1 |
|  |  | **(1)** |
| **1(d)** | –1.26376, -1.26126Accept answers which round to these answers to 5dp | M1 A1 |
|  |  | **(2)** |
| **1(e)** |  *α =* –1.26 and so turning point is at (-1.26, -2.55) | M1 A1cao |
|  |  | **(2)** |
|  |   | **(12 marks)** |
| **2(a)** |    |  |
|   | M1 |
|   | dM1 A1\* |
|  |   | **(3)** |
| **2(b)** |    | M1 A1 A1 |
|  |  | **(3)**  |
| **2(c)** |  Choosing (1.2715,1.2725)  |  |
|  or tighter containing root 1.271998323  | M1 |
|   | M1 |
|  Change of sign ⇒ α = 1.272 | A1 |
|  |  | **(3)** |
|  |  | **(9 marks)** |
| **3(a)** |  | M1 A1\* |
|  |  | **(2)** |
| **3(b)** | Sub  | M1 A1 |
| AWRT 4 dp.   | A1 |
|  |  | **(3)** |
| **3(c)** | Chooses interval [2.3065,2.3075] | M1 |
| *g*(2.3065)=-0.0002(7), *g*(2.3075)=0.004(4) | dM1 |
| Sign change , hence root (correct to 3dp) | A1 |
|  |   | **(3)** |
|  |  | **(8 marks)** |
| **4(a)** |  oe. | M1A1 |
|  | Puts to give *x* = -1 and *x* = 0 or one coordinate | dM1A1 |
|  | Obtains  CSO | A1 |
|  |  | **(5)** |
| **4(b)** | Puts  | B1\* |
|  |  | **(1)** |
| **4(c)** |  Subs  into  | M1A1 |
|  |   | A1 |
|  |  | **(3)** |
| **4(d)** |    , sign change and deduction  | B1B1 |
|  |  | **(2)** |
|  |  | **(11 marks)** |
| **5(a)** | (i) 21 | B1 |
| (ii)   | M1 A1 A1 |
| (iii) 25 | B1 |
|  |  | **(5)** |
| **5(b)** |  | M1 |
|   | A1\* |
|  |   | **(2)** |
| **5(c)** |  | M1 |
| awrt  | A1 |
|  |  | **(2)** |
| **5(d)** | Defines a suitable interval 1.4365 and 1.4375  | M1 |
| ...and substitutes into a suitable function, e.g. , obtains correct values with both a reason and conclusion | A1 |
|  |  | **(2)** |
|  |  | **(11 marks)** |
| **6(a)** | At P   | B1 |
|    | M1 A1 |
|   Equation of normal is   | M1 |
|    | A1 |
|  |   | **(5)** |
| **6(b)** | Combines  and  to form equation in *x* |  |
|   | M1 |
|   | dM1 A1\* |
|  |  | **(3)** |
| **6(c)** |  Substitutes   | M1 |
|   | A1 |
|  |   | **(2)** |
|  |  | **(10 marks)** |
| **7(a)** | Crosses *x*-axis  |  |  |
| Either  or  | Either one of {*x*}= 1 OR *x* = {8} | B1 |
| Coordinates are  and  | Both  and  | B1 |
|  |  | **(2)** |
| **7(b)** | Apply product rule:  |  | M1 |
|  | Any one term correct | A1 |
|  | Both terms correct | A1 |
|  |  | **(3)** |
| **7(c)** | Sign change (and asis continuous) therefore the *x*-coordinate of *Q* lies between 3.5 and 3.6. | Attempts to evaluate **both** and  | M1 |
|  | both values correct to at least 1 sf, sign change and conclusion | A1 |
|  |  |  | **(2)** |
| **7(d)** | At *Q*,  | Setting  | M1 |
|  | Splitting up the numerator and proceeding to *x* =  | M1 |
|  |  |  |
|  (as required) | For correct proof. No errors seen in working. | A1 |
|  |  | **(3)** |
| **7(e)** | Iterative formula:  |  |
|   | An attempt to substitute into the iterative formula.Can be implied by  | M1 |
|  | Both  and   | A1 |
|  |  |
|  |  |
|  to 3 dp. |  all stated correctly to 3 dp  | A1 |
|  |  | **(3)** |
|  |  | **(13 marks)** |
| **8(a)** | 2*x* + 1 – 3 = 17 – *x*  2*x* + 1 = 20 – *x*  | M1 |
| (*x* + 1) ln 2 = ln (20 – *x*)  *x* = …  | dM1 |
|   | A1\* |
|  |  | **(3)** |
| **8(b)** | Sub  into    (awrt) | M1 A1 |
| ,  (awrt) | A1 |
|  |  | **(3)** |
| **8(c)** | *A* = (3.1, 13.9) cao | M1 A1 |
|  |  | **(2)** |
|  |  | **(8 marks)** |
| **9(a)** |   ,   | M1 |
|  Change of sign⇒*Q* lies between | A1 |
|  |  | **(2)** |
| **9(b)** |  At *R*   | M1A1 |
|    cso | M1A1\* |
|  |   | **(4)** |
| **9(c)** |  | M1 |
|  | A1 |
|  |  | **(2)** |
|  |  | **(8 marks)** |
| **10(a)** | f(0.8) = 0.082, f(0.9)= –0.089 | M1 |
| Change of sign ⇒ root (0.8,0.9) | A1 |
|  |  | **(2)** |
| **10(b)** |  | M1 A1 |
| Sets    | M1 A1\* |
|  |  | **(4)** |
| **10(c)** | Sub *x*0 = 2 into  | M1 |
| *x*1 = awrt 1.921, *x*2 = awrt 1.91(0) and *x*3 = awrt 1.908 | A1 A1 |
|  |  | **(3)** |
| **10(d)** | [1.90775,1.90785] | M1 |
| f’(1.90775) = –0.00016... AND f’(1.90785) = 0.0000076... | M1 |
| Change of sign ⇒ *x* = 1.9078  | A1 |
|  |  | **(3)** |
|  |  | **(12 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | C3 June 2014R | 2 | 7.2, 2.7, 6.1, 9.1, 9.2 | Differentiation of exponential, graph of exponential, using iterative methods | 1.1b, 2.2a, 2.4 |
| 2 | C3 2012 | 2 | 9.1, 9.2 | Numerical methods | 1.1b, 2.1, 2.4 |
| 3 | C3 Jan 2013 | 2 | 9.1, 9.2, 6.3 | Numerical methods | 1.1b, 2.1. 2.4 |
| 4 | C3 2013 | 4 | 7.2, 7.4, 9.1, 9.2 | Differentiation and numerical analysis | 1.1b, 2.1, 2.2a, 2.4 |
| 5 | C3 2016 | 4 | 2.9, 6.3, 9.1, 9.2 | Modulus of exponential, iterative equation | 1.1b, 2.1, 2.4 |
| 6 | C3 2017 | 5 | 7.2, 7.3, 2.4, 9.2 | Normal to a function, leading to iterative methods | 1.1b, 2.1 |
| 7 | C3 Jan 2011 | 5 | 6.3, 7.3, 7.4, 9.1, 9.2 | Exponentials and logarithms, Differentiation, Numerical methods | 1.1b, 2.1, 2.4 |
| 8 | C3 2015 | 6 | 6.5, 9.2 | Intersection of graphs leading to iterative equation | 1.1b, 2.2a |
| 9 | C3 June 2014 | 6 | 7.2, 7.4, 9.1, 9.2 | Numerical methods | 1.1b, 2.1, 2.4 |
| 10 | C3 Jan 2012 | 6 | 7.2, 9.1, 9.2 | Numerical methods | 1.1b, 2.1, 2.4 |