| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |     | M1 |
|   | A1 |
|  |  | **(2)** |
| **1(b)** |    |  |
|   | M1 M1 |
|   | dM1 |
|   oe | A1 |
|  |   | **(4)** |
|  |  | **(6 marks)** |
| **2(a)** |   | M1 M1 |
| So  and  | A1 |
| Solve  to give  oe ( Ignore the solution ) | M1 A1 |
|  |  | **(5)** |
| **2(b)** |  Take loge’s to give   | M1 |
|  | M1 |
|   | dM1 |
|  and uses lne = 1 | M1 |
|   | A1 |
|  |  | **(5)** |
|  |  | **(10 marks)** |
| **3(a)(i)** |  | Shape | B1 |
|  | B1 |
|  | B1 |
|  |  | **(3)** |
| **3(a)(ii)** |  | Shape inc cusp | B1ft |
|  | B1ft |
|  | B1ft |
|  |  | **(3)** |
| **3(b)** |  | B1 ft |
|  |  | **(1)** |
| **3(c)** | 2e*x* – 5 = –2   | M1A1 |
|  | B1 |
|  |  | **(3)** |
|  |  | **(10 marks)** |
| **4(a)** |  f(*x*)>2 | B1 |
|  |  | **(1)** |
| **4(b)** |   | M1 A1 |
|  |   | **(2)** |
| **4(c)** |   | M1 A1 |
|   |  |
|   | M1 A1 |
|   | **(4)** |
| **4(d)** |  Let  | M1 |
|   | A1 B1ft |
|  |  | **(3)** |
| **4(e)** |  |  Shape for f(*x*) | B1 |
|  (0, 3) | B1 |
|  Shape for f-1(*x*) | B1 |
|  (3, 0) | B1 |
|  |  | **(14 marks)** |
| **5(a)** |  | B1 |
|  |  | **(1)** |
| **5(b)** |  | M1 |
|    | dM1 |
|   | A1 |
|  |  | **(3)** |
| **5(c)** |  | M1 |
|  | M1 |
|  | M1 |
|  (Ignore any reference to ) | A1 |
|  |  | **(4)** |
| **5(d)** |  | M1 |
|  | A1 |
|  |  | **(2)** |
| **5(e)** |  |  |
|   | M1 |
|  **only** | A1 |
|  |  | **(2)** |
|  |  | **(12 marks)** |
| **6(a)** | 20 (mm2) | B1 |
|  |  | **(1)** |
| **6(b)** | ‘40’ = 20 e1.5*t*  e1.5*t* = *c*  | M1 |
| e1.5*t* =  | A1 |
| Correct order 1.5*t* = ln’2’    | M1 |
|  = (awrt 0.46) | A1 |
|  12.28 or 28 (minutes} | A1 |
|  |  | **(5)** |
|  |  | **(6 marks)** |
| **7(a)** | (*θ* = ) 20 | B1 |
|  |  | **(1)** |
| **7(b)** | Sub *t* = 40, *θ* = 70  70 = 120 – 100 e–40*λ* |  |
|   e–40*λ* = 0.5 | M1A1 |
|    | M1A1 |
|  |  | **(4)** |
| **7(c)** | *θ* = 100    | M1 |
|    | A1 |
|  |  | **(2)** |
|  |   | **(7 marks)** |
| **8(a)** |  | M1A1 |
|  |  | **(2)** |
| **8(b)** |  | M1A1 |
|  |  | **(2)** |
| **8(c)** |  | M1 |
| or  | **d**M1 |
|  | M1 |
|  | A1 **cso** |
|  |  | **(4)** |
|  |  | **(8 marks)** |
| **9(a)** |  or  or ;   | B1 B1 |
| Eliminate *a* to give  or .. (not a cubic)  | aM1 |
| (and so *r*2 =  and**)** *r* =only  | aA1 |
|  |  | **(4)** |
| **9(b)** | Substitute their *r* = ( 0 *< r* < 1) to give *a* =  | bM1 |
| *a* = 18 | bA1 |
|  |  | **(2)** |
| **9(c)** |   (For trial and improvement approach see notes below) | M1 |
| to obtain So or equivalent e.g. or  | A1 |
| So *n* >  or  or equivalent but must be log of positive quantity | M1 |
| (i.e. *n* > 27.9 ) so *n* = 28  | A1 |
|  |  | **(4)** |
|  |  | **(10 marks)** |
| **10(a)** | (£) 19500 | B1 |
|  |  | **(1)** |
| **10(b)** |   |  |
|   |  |
|   |  |
|   | M1 |
|   | M1 |
|   | A1 |
|    | A1 |
|  |  | **(4)** |
| **10(c)** |   | M1A1 |
|  When *t* = 8 Decrease = 593 (£/year)  | M1A1 |
|  |  | **(4)** |
|  |  | **(9 marks)** |
| **11(a)** |  Subs and *t* =4  | M1 A1 |
|  |  | **(2)** |
| **11(b)** |   | M1 A1\* |
|  |  | **(2)** |
| **11(c)** |  | M1 |
|  |  |
|  | dM1 |
|   | A1 A1 |
|  |  | **(4)** |
|  |  | **(8 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | C3 June 2014 | 2 | 6.3 | Solving exponential and ln equations | 1.1b |
| 2 | C3 2013 | 6 | 6.3, 6.4 | Exponentials and logarithms | 1.1b, 3.1a |
| 3 | C3 2015 | 2 | 6.1, 2.9, 6.5 | The exponential graph and modulus leading to solving equations | 1.1b, 2.1, 2.2a |
| 4 | C3 2012 | 6 | 2.8, 6.1, 6.3 | Composite and inverse functions, Exponentials and logarithms | 1.1b, 2.5 |
| 5 | C3 June 2014R | 6 | 2.8, 6.1, 6.3, 6.4 | Functions, Logarithms | 1.1b, 3.1a |
| 6 | C3 Jan 2012 | 3 | 6.3, 6.7 | Exponentials and logarithms | 1.1b, 3.2a, 3.4 |
| 7 | C3 2015 | 4 | 6.1, 6.3 | Exponential functions and related equations | 1.1b, 3.4 |
| 8 | C2 2014 | 6 | 4.5, 6.3 and 6.5 | Geometric series, Exponentials and logarithms | 1.1b, 2.2a and 2.4 |
| 9 | C2 2015 | 5 | 4.5, 6.5, 2.4 | Geometric series, Exponentials and logarithms | 1.1b |
| 10 | C3 Jan 2013 | 8 | 6.2, 6.3, 6.7 | Exponentials and logarithms | 1.1b, 3.1a, 3.2a, 3.4 |
| 11 | C3 2016 | 9 | 6.1, 6.3, 6.5, 6.7 | Exponential problem | 1.1b, 2.1, 3.1b, 3.4 |