| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |   | B1 |
|    | M1 |
|    any two constants correct | A1 |
|  Coefficients of  |  |
|  all three constants correct | A1 |
|  |  | **(4)** |
| **1(b)** | (i)  |  |
|   | M1 A1ft A1ft |
|   |  |
| (ii)  |  |
|   | M1 |
|   | M1 |
|   | A1 |
|  |  |  **(6)** |
|  |  | **(10 marks)** |
| **2** |   | M1 A1 A1 |
|   | M1 |
|   | M1 A1 |
|  |  | **(6 marks)** |
| **3(a)** | ,  |  |
|  | In the form  | M1 |
|  simplified or un-simplified. | A1 |
|  simplified or un-simplified. |  |
|  |  |
|  |  | dM1 |
| Correct answer, with/without   | A1 |
|  |  |  **(5)** |
| **3(b)** |  |  |
| Applies limits of 2 and 1 to their part (a) answer and subtracts the correct way round. | M1 |
|  or equivalent. | A1 |
|  |  |  **(2)** |
|  |  | **(7 marks)** |
| **4(a)** |  | M1 A1 |
|  | A1 |
|  |  |  **(3)** |
| **4(b)** |  | M1 A1 |
|  | A1  **isw** |
|   |  |
|  | *Ignore subsequent working* |  **(3)** |
|  |  | **(6 marks)** |
| **5(a)** |  |  |
|  |  |
|   | M1 |
| A1 |
|  |  |  **(2)** |
| **5(b)** |  | M1 |
| A1 |
|  | A1 |
|  |  |  **(3)** |
| **5(c)** |  | B1 |
|  |  |
|  | M1 |
|  |  |
|  | A1 |
|  |  |  **(3)** |
|  |  | **(8 marks)** |
| **6(a)** | 1.154701 | B1 **cao** |
|  |  | **(1)** |
| **6(b)** |  | B1 M1 |
| (4 dp) | 1.7787 or awrt 1.7787  | A1 |
|  |  | **(3)** |
| **6(c)** |   | For . Ignore limits and .Can be implied. | B1 |
|   |  | M1 |
|  |  or equivalent | A1 |
|   |  | A1 **cao** **cso** |
|  |  | **(4)**  |
|  |  | **(8 marks)** |
| **7(a)** |   |  |
|   |  |
|    | M1 A1 |
|    | A1 |
|  |  | **(3)** |
| **7(b)**  |  |  |
|  ft constants | M1 A1ft A1ft |
|  |  |  **(3)** |
| **7(c)** |  | M1 |
|  | M1 A1 |
|  depends on first two Ms in (c) | M1 dep |
| Using   depends on first two Ms in (c) | M1 dep |
|  | A1 |
|  |  | **(6)** |
|  |  | **(12 marks)** |
| **8(a)** |  | M1A1A1 |
|    | M1 A1 ftA1 **cao** |
|  |  | **(6)** |
| **8(b)** |  or  or  | B1 |
| or  | M1 |
|  |  |
|  | A1 |
|   | B1 |
|  |  | **(5)** |
| **8(c)** |  | M1 |
|  | M1 A1 |
|  |  |
|  o.e. | A1 |
|  |  | **(4)** |
|  |  | **(15 marks)** |
| **9(a)** |  *Working parametrically:* |  |
|  |  |
|  | Applies  to obtain a value for *t*. | M1 |
| When ,  | Correct value for *y*. | A1 |
|  |  | **(2)** |
| **9(b)** |  | Applies  to obtain a value for *t*.(Must be seen in part (b)). | M1 |
| When ,  |  | A1 |
|  |  | **(2)** |
| **9(c)** |  and either  or  | B1 |
|  | Attempts their  divided by their   | M1 |
| At *A*,  so   | Applies  and  | M1 |
|  or  or equivalent. | M1 A1 oe cso |
|  |  | **(5)** |
| **9(d)** |  | Complete substitution for both  and  | M1 |
|  | B1 |
| Either  or  or  | M1\* |
|  | A1 |
|  |  |
| **Depends on the previous method mark.**Substitutes their changed limits in *t* and subtracts either way round. | dM1\* |
|  |  or equivalent. | A1 |
|  |  | **(6)** |
|  |  | **(16 marks)** |
| **10(a)** |  |  |
|  | B1 |
|  |  |
|  | M1 |
|  |  |
|  |  |
|  | M1 |
| ,  | A1 |
|  **and**   | B1 |
|  |  |  **(5)** |
| **10(b)** |  | M1 |
|  | M1 |
|  |  |
|  | A1**cao cso** |
|  |  |  **(3)** |
|  |  | **(8 marks)** |
| **11(a)** |  |  |
|  | M1 |
|  so  | A1 |
|  |  | **(2)** |
| **11(b)** |  | B1 |
|  | M1 |
|  | A1 \* |
|  | B1 |
|  |  | **(4)** |
| **11(c)** |  | M1 |
| dM1 |
|  **or**  | A1 |
|    or  where  or  where  | M1 |
| A1 |
|  |
|  |  |
|  **or** **or**   **or**  | A1 o.e. |
|  |  | **(6)** |
|  |  | **(12 marks)** |
| **12(a)** |  | Can be implied. | M1 |
|  | Either one. | A1 |
| giving   | A1 **cao, aef** |
|  |  |  **(3)** |
| **12(b)** |  | B1 |
|   | M1\* |
| A1ft |
|    | dM1\* |
| e.g.:  | Using any of the subtraction (or addition) laws for logarithms CORRECTLY | dM1\* |
|   |  |
| e.g.:  or e.g.:  | Eliminate ln’s correctly. | dM1\* |
| gives  |  |  |
|   | Make *P* the subject. | dM1\* |
|  or  etc. | A1 |
|  |   |  **(8)** |
| **12(c)** | **.** So population cannot exceed 5000. | B1 |
|  |  |  **(1)** |
|  |  | **(12 marks)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | C4 2012 | 1 | 2.10, 8.6 | Partial fractions, Integration | 1.1b |
| 2 | C4 Jan 2011 | 1 | 8.4, 5.3 | Integration | 1.1b |
| 3 | C4 Jan 2013 | 2 | 8.2, 8.5 | Integration | 1.1b |
| 4 | C4 Jan 2012 | 2 | 8.2, 8.5 | Integration | 1.1b,  |
| 5 | C4 2015 | 3 | 6.3, 8.5 | Integration | 1.1b, 2.1, 3.1a |
| 6 | C4 2013 | 3 | 8.2, 8.5, 6.4 | Integration | 1.1b, 2.1 |
| 7 | C4 Jan 2011 | 3 | 2.10, 8.6, 8.7 | Algebra and functions, Integration | 1.1b, 3.1a |
| 8 | C4 2016 | 6 | 8.5, 8.6 | Integration | 1.1b, 2.1, 3.1a |
| 9 | C4 Jan 2013 | 5 | 3.3, 7.3, 7.5, 8.3, 8.5 | Parametric curves and equations, Parametric differentiation, Integration | 1.1b, 3.1a |
| 10 | C4 2015 | 6 | 8.2, 8.3, 8.5 | Integration | 1.1b, 2.1 |
| 11 | C4 2017 | 8 | 5.4, 7.4, 8.3, 8.5 | Parametric curves and equations, Integration | 1.1b, 2.1, 3.1a |
| 12 | C4 Jan 2012 | 8 | 2.10, 8.6, 8.7, 8.8, 2.11 | Partial fractions, Integration | 1.1b, 2.1, 3.1a, 3.4 |