| **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)** |  | | | | | | M1  A1  A1 |
|  | | | | | | M1 A1 ft  A1 **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 |