| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | *x* | 1 | 1.25 | 1.5 | 1.75 | 2 |
|  | *y* | 1.414 | **1.601** | 1.803 | 2.016 | 2.236 |

 |  |
|  | B1 cao |
|  |  | **(1)** |
| **1(b)** |  | B1 M1 A1ft |
|  | 1.81 or  | A1 |
|  |  | **(4)** |
|  |  | **(5 marks)** |
| **2(a)** | 7 | B1 cao |
|  |  | **(1)** |
| **2(b)** |  | B1 M1 |
| o.e. | A1 cao |
|  |  | **(3)** |
| **2(c)** |   | M1 |
|  | A1 cao |
|  |  | **(2)** |
|  |  | **(6 marks)** |
| **3(a)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  *x* | 0 | 0.5 | 1 | 1.5 | 2 |
|  *y* | 1 | 2.821 | **6** | 12.502 | 26.585 |

 |  |
| (allow 6.000 or even 6.00) | B1 cao |
|  |  | **(1)** |
| **3(b)** |  | B1 oe |
|  | For structure of  | M1A1ft |
|  | A1 |
|  |  | **(4)** |
| **3(c)** | 10 + “17.56” = “27.56” | B1ft |
|  |  | **(1)** |
|  |  | **(6 marks)** |
| **4(a)** |  | B1 |
|  |  | **(1)** |
| **4(b)** |  | B1 |
| M1 |
| Note decimal values are  |  |
|  |  |
| (2dp) | 25.76 | A1 **cao** |
|  |  | **(3)** |
| **4(c)** | underestimate | B1 |
|  |  | **(1)** |
|  |  | **(5 marks)** |
| **5(a)** |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *x* | 0 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 |
|  | *y* | 5 | 4 | 2.5 | 1.538 | 1 | 0.690 | 0.5 |

 |  |
|  | B1 **cao** |
|  |  | **(1)** |
| **5(b)** |  | B1 oe |
|  | For structure of ; | M1A1ft |
|  | A1 |
|  |  | **(4)** |
| **5(c)** | Adds Area of Rectangle or first integral to **previous answer**  | M1 |
| So required estimate =  (or 12 + previous answer). | A1ft |
| N.B.+ previous answer is M0A0 (added 4 seven times because 7 numbers in table) |  |
|  |  | **(2)** |
|  |  | **(7 marks)** |
| **6(a)** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *x* | 1 | 1.2 | 1.4 | 1.6 | 1.8 | 2 |
|   | *y* | 0 | 0.2625 | ***0.659485...*** | 1.2032 | 1.9044 | 2.7726 |

 |  |
|  | B1 cao |
|  |  | **(1)** |
| **6(b)** |  | B1 M1 |
|  | A1 |
|  |  | **(3)** |
| **6(c)** | ,   |  |
|  | M1 A1 |
|  | A1 |
|  | dM1 |
|  o.e. | A1 cso |
|  |  | **(5)** |
|  |  | **(9 marks)** |
| **7(a)** |  | B1 M1 |
|  (2 dp) | A **cao** |
|  |  | **(3)** |
| **7(b)** | Any one of  |  |
| * Increase the number of strips
* Use more trapezia
* Make *h* smaller
* Increase the **number of** *x* and/or *y* values used
* Shorter /smaller intervals for *x*
* More values of *y*.
* More intervals of *x*
* Increase *n*
 | B1 |
|  |  | **(1)** |
| **7(c)** | ,   |  |
|  | M1 |
| A1 |
|  | A1 oe |
|  | dM1 |
|  | A1 oe |
|  |  | **(5)** |
|  |  | **(9 marks)** |
| **8(a)** |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | *x* | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1 |
|   | *y* | 2 | ***1.8625426...*** | 1.71830 | 1.56981 | 1.41994 | 1.27165 |

 |  |
|  | B1 **cao** |
|  |  | **(1)** |
| **8(b)** |  | B1 o.e. |
|  | M1 |
|  | A1 |
|  |  | **(3)** |
| **8(c)** |  |  |
|  **or**  **or**  **or**  etc., **and**  | B1 \* |
|   | B1 |
|  |  | **(2)** |
| **8(d)** |  | M1 |
| A1 |
|     | M1 |
|  | A1 ft |
|    | dM1 |
|  **or**   **or**  **or**   **or**   **or**   **or**  | A1 **cso** |
|  |  | **(6)** |
|  |  | **(12 marks)** |
| **9(a)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *x* | 1 | 2 | 3 | 4 |
|   | *y* | 1.42857 | 0.90326 | ***0.682116...*** | 0.55556 |

 |  |
|  |  |
|  | 0.68212  | B1 **cao** |
|  |  | **(1)** |
| **9(b)** |  | Outside brackets  or   | B1 aef |
| For structure of  | M1 |
|  | anything that rounds to 2.5774 | A1 |
|  |  | **(3)** |
| **9(c)** | Overestimate **and** a reason such as* {top of} trapezia lie above the curve
* a diagram which gives reference to the extra area
* concave or convex
* (can be implied)
* bends inwards
* curves downwards
 | B1 |
|  |  | **(1)** |
| **9(d)** |  or  | B1 |
|   | Either  or  | M1 |
|   | **with no other terms.** | M1 |
|  | A1 **cso** |
| Substitutes limits of 2 and 1 in *u* (or 4 and 1 in *x*) and subtracts the correct way round. | M1 |
|  or  or   | A1 oe **cso** |
|  |  | **(6)** |
|  |  | **(11 marks)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | C2 2014 | 1 | 9.3 | Numerical integration | 1.1b |
| 2 | C2 2016 | 2 | 8.3, 9.3 | Integration, Numerical methods | 1.1b and 3.1a |
| 3 | C2 2017 | 3 | 6.1, 9.3 | Trapezium rule | 1.1b and 2.2 |
| 4 | C2 June 2014R | 3 | 9.3 | Numerical integration | 1.1b, 2.4 |
| 5 | C2 2013 | 4 | 9.3 | Integration, numerical integration | 1.1b, 2.2a, 3.1a |
| 6 | C4 2016 | 2 | 9.4, 8.5 | Integration, Numerical methods | 1.1b |
| 7 | C4 June 2014R | 2 | 8.5 ,9.4 | Trapezium rule, Integration by parts | 1.1b, 3.1a, 2.4 |
| 8 | C4 2017 | 3 | 8.5, 8.6, 9.4  | Integration | 1.1b, 2.1, 3.1a |
| 9 | C4 June 2014 | 3 | 9.4, 8.5, 8.3, 8.2 | Integration, numerical integration | 1.1b, 2.4 |