| **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 |