**Set 12**

**MARK SCHEME**

**PURE MATHEMATICS**

**A level Practice Paper**

**1**

|  |  |
| --- | --- |
| Recognises that two subsequent values will divide to give an equal ratio and sets up an  appropriate equation. | **M1** |
| Makes an attempt to solve the equation. For example,  or | **M1** |
| Factorises to get | **M1** |
| States the correct solution: *k* = 6.  or *k* = 0 is trivial may also be seen, but is not required. | **A1** |
| **TOTAL: 4 marks** |  |

|  |  |
| --- | --- |
| Recognises the need to use the chain rule to find  **2**  For exampleis seen. | **M1** |
| Findsand | **M1** |
| Makes an attempt to substitute known values. For example, | **M1** |
| Simplifies and states | **A1** |
| **TOTAL: 4 marks** |  |

|  |  |
| --- | --- |
| Recognises that the identity can be used to find the cartesian equation.  **3** | **M1** |
| States or Also states | **M1** |
| Substitutesandinto | **M1** |
| Solves to find, accept *x* < 1 or | **A1** |
| **TOTAL: 4 marks** |  |

**4**

|  |  |
| --- | --- |
| States that: | **M1** |
| Equates the various terms.  Equating the coefficients of *x*:  Equating constant terms: | **M1\*** |
| Multiplies both of the equations in an effort to equate one of the two variables. | **M1\*** |
| Finds *A* = 8 | **A1** |
| Find *B* = −2 | **A1** |
| **TOTAL: 5 marks** |  |

Alternative method

Uses the substitution method, having first obtained this equation: 

Substitutes  to obtain *B* = 27 (**M1**)

Substitutes  to obtain *A* = 43.2 (**M1**)

|  |  |
| --- | --- |
| Differentiates 4*x* to obtain 4*x* ln 4  **5** | **M1** |
| Differentiates 2*xy* to obtain | **M1** |
| Rearrangesto obtain | **A1** |
| Makes an attempt to substitute (2, 4) | **M1** |
| States fully correct final answer: Accept | **A1** |
| **TOTAL: 5 marks** |  |

|  |  |
| --- | --- |
| Equating the coefficients of *x*4: *A* = 5  **6** | **A1** |
| Equating the coefficients of *x*3: *B* = −4 | **A1** |
| Equating the coefficients of *x*2: 2*A* + *C* = 17, *C* = 7 | **A1** |
| Equating the coefficients of *x*: 2*B* + *D* = −5, *D* = 3 | **A1** |
| Equating constant terms: 2*C* + *E* = 7, *E* = −7 | **A1** |
| **TOTAL: 5 marks** |  |

**7a**

|  |  |
| --- | --- |
| Correctly states that | **M1** |
| Simplifies to obtain … | **M1** |
| Deduces that | **M1** |
| Solves to find | **A1** |
|  | **(4 marks)** |
| . Award mark for –500 seen.  **7b** | **A1** |
| . Award mark for 500 seen. | **A1** |
|  | **(2 marks)** |
| **TOTAL: 6 marks** |  |

8a

|  |  |
| --- | --- |
| States that | **A1** |
| Attempts to substitute  into .  and simplifies to find | **A1** |
|  | **(2 marks)** |
| States  or  8b | **M1** |
| Factorises to get | **M1** |
| States *p* = 5. May also state that , but mark can be awarded without that being seen. | **A1** |
|  | **(3 marks)** |
| 8c | **A1 ft** |
|  | **(1 mark)** |
| **TOTAL: 6 marks** |  |

**NOTES: 8c:** Award mark for a correct answer using their value of *p* from part **b**.

|  |  |
| --- | --- |
| States  9a | **M1** |
| Makes an attempt to solve the equation. For example,is seen. | **M1** |
| States *k* = 2 and *k* = 18 | **A1** |
|  | **(3 marks)** |
| Finds the vector  9b | **M1 ft** |
| Finds | **M1 ft** |
| States the unit vector | **A1 ft** |
|  | **(3 marks)** |
| **TOTAL: 6 marks** |  |

**NOTES: 9b**

Award ft marks for a correct answer topart **b** using their incorrect answer frompart **a.**

10a

|  |  |
| --- | --- |
| Makes an attempt to find . For example, writing | **M1** |
| Uses the law of logarithms to write | **M1** |
| States that | **A1** |
| States that the range is  or | **B1** |
|  | **(4 marks)** |
| States that  10b | **M1** |
| Makes an attempt to solve for *x*, including attempting to take the square root of both sides of  the equation. For example, | **M1** |
| States that *x* = 8. Does not need to state that ,  but do not award the mark if *x* = −10 is stated. | **A1** |
|  | **(3 marks)** |
| **TOTAL: 7 marks** |  |

|  |  |
| --- | --- |
| Rearranges to find  11a | **M1** |
| Statesand thereforeand or states | **A1** |
|  | **(2 marks** |
| Attempts to use iterative procedure to find subsequent values. | **M1** |
| Correctly finds:  11b | **A1** |
|  | **(2 marks)** |
| Demonstrates an understanding that the two values of f(*x*) to be calculated are for  11c  *x* = –2.7815 and *x* = –2.7825. | **M1\*** |
| Finds and | **M1** |
| Change of sign and continuous function in the interval root | **A1** |
|  | **(3 marks)** |
| **TOTAL: 7 marks** |  |

**NOTES:**

**11b**

Award M1 if finds at least one correct answer.

**11c**

Any two numbers that produce a change of sign, where one is greater than –2.782 and one

is less than –2.782, and both numbers round to –2.782 to 3 decimal places, are acceptable.

Minimum required is that answer states there is a sign change in the interval and that this implies a root in the given interval.

|  |  |
| --- | --- |
| Recognises the need to write  12a | **M1** |
| Recognises the need to write | **M1** |
| Multiplies out the bracket and makes a further substitution | **M1** |
| States the fully correct final answer | **A1** |
|  | **(4 marks)** |
| States or implies that  12b | **M1** |
| States fully correct integral | **M1** |
| Makes an attempt to substitute the limits.  For example, is seen. | **M1 ft** |
| Begins to simplify the expression | **M1 ft** |
| States the correct final answer | **A1 ft** |
|  | **(5 marks)** |
| **TOTAL: 9 marks** |  |

**NOTES:**

**12b**

Student does not need to state ‘+C’ to be awarded the second method mark.

**12b**

Award ft marks for a correct answer using an incorrect initial answer.

|  |  |
| --- | --- |
| Begins the proof by assuming the opposite is true.  13a  ‘Assumption: there exists a number *n* such that *n2* is even and *n* is odd.’ | **B1** |
| Defines an odd number (choice of variable is not important) and successfully calculates *n2*  Let 2*k +* 1 be an odd number. | **M1** |
| Factors the expression and concludes that this number must be odd.  , so *n*2 is odd. | **M1** |
| Makes a valid conclusion.  This contradicts the assumption *n*2 is even. Therefore if *n*2 is even, *n* must be even. | **B1** |
|  | **(4 marks)** |
| Begins the proof by assuming the opposite is true.  13b  ‘Assumption:is a rational number.’ | **B1** |
| Defines the rational number:  for some integers *a* and *b*, where *a* and *b* have no common factors. | **M1** |
| Squares both sides and concludes that *a* is even:    From part **a**: *a*2 is even implies that *a* is even. | **M1** |
| Further states that if *a* is even, then *a =* 2*c*. Choice of variable is not important. | **M1** |
| Makes a substitution and works through to find , concluding that *b* is also even.    From part **a**: *b*2 is even implies that *b* is even. | **M1** |
| Makes a valid conclusion.  If *a* and *b* are even, then they have a common factor of 2, which contradicts the statement that  *a* and *b* have no common factors.  Thereforeis an irrational number. | **B1** |
|  | **(6 marks)** |
| **TOTAL: 10 marks** |  |

14a

|  |  |
| --- | --- |
| States | **M1** |
| Separates the variables | **M1** |
| Finds | **A1** |
| Shows clearly progression to state  For example, is seen. May also explain the  whereis a constant. | **A1** |
| 14b | **(4 marks)** |
| States | **M1** |
| Simplifies the expression by cancelling  and then taking the natural log of both sides | **M1** |
| States that | **A1** |
| 14c | **(3 marks)** |
| States | **M1** |
| Simplifies the expression by cancelling  and then taking the natural log of both sides | **M1** |
| Finds *t* = 18.613… years. Accept 18.6 years. | **A1** |
|  | **(3 marks)** |
| **TOTAL: 10 marks** |  |

|  |  |
| --- | --- |
| States:  15a  Or: | **M1** |
| Deduces that: | **M1** |
| States that  Use of might be seen, but is not necessary to award the mark. | **A1** |
| Finds that  might be seen, but is not necessary to award the mark. | **A1** |
|  | **(4 marks)** |
| Uses the maths from part **a** to deduce that  15b | **A1** |
| Recognises that the maximum temperature occurs when | **M1** |
| Solves this equation to find | **M1** |
| Finds *x* = 15.81 hours | **A1** |
|  | **(4 marks)** |
| Deduces that  15c | **M1** |
| Begins to solve the equation. For example,  is seen. | **M1** |
| States that  Further values may be seen, but are not necessary in order to award the mark. | **M1** |
| Finds that *x* = 2.65 hours, 10.13 hours, 21.50 hours | **A1** |
|  | **(4 marks)** |
| **TOTAL: 12 marks** |  |

**(TOTAL: 100 MARKS)**