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| 1 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States that: | **M1** | 2.2a | 5th  Decompose algebraic fractions into partial fractions − two linear factors. |
| Equates the various terms.  Equating the coefficients of *x*:  Equating constant terms: | **M1\*** | 2.2a |
| Multiplies both of the equations in an effort to equate one of the two variables. | **M1\*** | 1.1b |
| Finds *A* = 8 | **A1** | 1.1b |
| Find *B* = −2 | **A1** | 1.1b |
| (5 marks) | | | | |
| Notes  Alternative method  Uses the substitution method, having first obtained this equation:  Substitutes  to obtain *B* = 27 (**M1**)  Substitutes  to obtain *A* = 43.2 (**M1**) | | | | |

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| 2 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Begins the proof by assuming the opposite is true.  ‘Assumption: there do exist integers *a* and *b* such that ’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Understands that  ‘As both 25 and 15 are multiples of 5, divide both sides by 5 to leave ’ | **M1** | 2.2a |
| Understands that if *a* and *b* are integers, then 5*a* is an integer, 3*b* is an integer and 5*a +* 3*b* is also an integer. | **M1** | 1.1b |
| Recognises that this contradicts the statement that , asis not an integer. Therefore there do not exist integers *a* and *b* such that ’ | **B1** | 2.4 |
| (4 marks) | | | | |
| **Notes** | | | | |

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| 3 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Finds and | **M1** | 1.1b | 6th  Differentiate simple functions defined parametrically including application to tangents and normals. |
| Writes −2sin 2*t* = − 4sin *t* cos *t* | **M1** | 2.2a |
| Calculates | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(b)** | Evaluatesat | **A1 ft** | 1.1b | 6th  Differentiate simple functions defined parametrically including application to tangents and normals. |
| Understands that the gradient of the tangent is, and then the gradient of the normal is −2. | **M1 ft** | 1.1b |
| Finds the values of *x* and *y* at  and | **M1 ft** | 1.1b |
| Attempts to substitute values into  For example, is seen. | **M1 ft** | 2.2a |
| Shows logical progression to simplify algebra, arriving at: or | **A1** | 2.4 |
|  | **(5)** |  |  |
| (8 marks) | | | | |
| Notes  **(b)** Award ft marks for a correct answer using an incorrect answer from part **a**. | | | | |

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| 4 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States that | **M1** | 2.2a | 6th  Integrate using trigonometric identities. |
| Makes an attempt to find  Writingor writing ln (sin *x*) constitutes an attempt. | **M1** | 2.2a |
| States a fully correct answer | **A1** | 1.1b |
| (3 marks) | | | | |
| **Notes** | | | | |

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| 5 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Demonstrates an attempt to find the vectors,and | **M1** | 2.2a | 5th  Find the magnitude of a vector in 3 dimensions. |
| Finds,and | **A1** | 1.1b |
| Demonstrates an attempt to find,and | **M1** | 2.2a |
| Finds  Finds  Finds | **A1** | 1.1b |
| States or implies in a right-angled triangle | **M1** | 2.2a |
| States that | **B1** | 2.1 |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 6 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | States or implies that | **M1** | 2.2a | 5th  Find composite functions. |
| States or implies that | **M1** | 2.2a |
| Makes an attempt to solve . For example,  or  is seen. | **M1** | 1.1b |
| States that . Must show all steps and a logical progression. | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(b)** |  | **M1\*** | 2.2a | 5th  Find the domain and range of composite functions. |
| States that as there are no real solutions to the equation. | **B1\*** | 3.2b |
|  | **(2)** |  |  |
| (6 marks) | | | | |
| Notes  (b) Alternative Method  M1: Uses the method of completing the square to show that  or  B1: Concludes that this equation will have no real solutions. | | | | |

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| 7 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Begins the proof by assuming the opposite is true.  ‘Assumption: there is a finite amount of prime numbers.’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Considers what having a finite amount of prime numbers means by making an attempt to list them:  Let all the prime numbers exist be | **M1** | 2.2a |
| Consider a new number that is one greater than the product of all the existing prime numbers:  Let | **M1** | 1.1b |
| Understands the implication of this new number is that division by any of the existing prime numbers will leave a remainder of 1. So none of the existing prime numbers is a factor of *N*. | **M1** | 1.1b |
| Concludes that either *N* is prime or *N* has a prime factor that is not currently listed. | **B1** | 2.4 |
| Recognises that either way this leads to a contradiction, and therefore there is an infinite number of prime numbers. | **B1** | 2.4 |
| (6 marks) | | | | |
| Notes  If *N* is prime, it is a new prime number separate to the finite list of prime numbers, .  If *N* is divisible by a previously unknown prime number, that prime number is also separate to the finite list of prime numbers. | | | | |

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| 8 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Attempts to write a differential equation.  For example,oris seen. | **M1** | 3.1a | 7th  Construct simple differential equations. |
| States | **A1** | 3.1a |
| (2 marks) | | | | |
| **Notes** | | | | |

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| 9 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Recognises that it is a geometric series with a first term  and common ratio | **M1** | 3.1a | 6th  Use geometric sequences and series in context. |
| Attempts to use the sum of a geometric series. For example,  or  is seen. | **M1\*** | 2.2a |
| Finds | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(b)** | States  or | **M1** | 3.1a | 5th  Use arithmetic sequences and series in context. |
| Begins to simplify.  or | **M1** | 1.1b |
| Applies law of logarithms correctly  or | **M1** | 2.2a |
| States | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(c)** | Uses the sum of an arithmetic series to state | **M1** | 3.1a | 5th  Use arithmetic sequences and series in context. |
| Solves for *d*. *d* = £11.21 | **A1** | 1.1b |
|  | **(2)** |  |  |
| (9 marks) | | | | |
| Notes  **M1**  Award mark if attempt to calculate the amount of money after 1, 2, 3,….,8 and 9 months is seen. | | | | |

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| 10 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Selects as the appropriate trigonometric identity. | **M1** | 2.2a | 6th  Integrate using trigonometric identities. |
| Manipulates the identity to the question: | **M1** | 1.1b |
| States that | **M1** | 1.1b |
| Makes an attempt to integrate the expression, *x* and sin *x* are seen. | **M1** | 1.1b |
| Correctly states | **A1** | 1.1b |
| (5 marks) | | | | |
| Notes  Student does not need to state ‘+C’ to be awarded the third method mark. Must be stated in the final answer. | | | | |

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| 11 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Writes tan*x* and sec*x* in terms of sin*x* and cos*x*. For example, | **M1** | 2.1 | 5th  Understand the functions sec, cosec and cot. |
| Manipulates the expression to find | **M1** | 1.1b |
| Simplifies to find | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(b)** | States thator | **B1** | 2.2a | 6th  Use the functions sec, cosec and cot to solve simple trigonometric problems. |
| Writes thator | **M1** | 1.1b |
| Finds | **A1** | 1.1b |
|  | **(3)** |  |  |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 12 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Rearrangesto obtain | **M1** | 1.1b | 8th  Use parametric equations in modelling in a variety of contexts. |
| Substitutesinto  For example,is seen. | **M1** | 1.1b |
| Finds | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(b)** | Deduces that the width of the arch can be found by substituting  into | **M1** | 3.4 | 8th  Use parametric equations in modelling in a variety of contexts. |
| Finds *x* = 0 and *x* = 160 and deduces the width of the arch is 160 m. | **A1** | 3.2a |
|  | **(2)** |  |  |
| **(c)** | Deduces that the greatest height occurs when | **M1** | 3.4 | 8th  Use parametric equations in modelling in a variety of contexts. |
| Deduces that the height is 100 m. | **A1** | 3.2a |
|  | **(2)** |  |  |
| (7 marks) | | | | |
| Notes | | | | |

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| 13 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Makes an attempt to set up a long division.  For example:  is seen. | **M1** | 2.2a | 5th  Divide polynomials by linear expressions with a remainder. |
| Award 1 accuracy mark for each of the following:  seen, 2*x* seen, −21 seen.  For the final accuracy mark either *D* = 138 or  or the remainder is 138 must be seen. | **A4** | 1.1b |
| (5 marks) | | | | |
| Notes  This question can be solved by first writing  and then solving for *A*, *B*, *C* and *D*. Award 1 mark for the setting up the problem as described. Then award 1 mark for each correct coefficient found. For example:  Equating the coefficients of *x*3: *A* = 1  Equating the coefficients of *x*2: 6 + *B* = 8, so *B* = 2  Equating the coefficients of *x*: 12 + *C* = −9, so *C* = −21  Equating the constant terms: −126 + *D* = 12, so *D* = 138. | | | | |

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| 14 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Recognises the need to use the chain rule to find  For exampleis seen. | **M1** | 3.1a | 8th  Construct differential equations in a range of contexts. |
| Findsand | **M1** | 2.2a |
| Makes an attempt to substitute known values. For example, | **M1** | 1.1b |
| Simplifies and states | **A1** | 1.1b |
| (4 marks) | | | | |
| **Notes** | | | | |

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|  | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **15** | Recognises the need to write | **M1** | 2.2a | 6th  Integrate using trigonometric identities. |
| Selects the correct trigonometric identity to write . Could also write | **M1** | 2.2a |
| Makes an attempt to find | **M1** | 1.1b |
| Correctly states answer | **A1** | 1.1b |
| (4 marks) | | | | |
| **Notes** | | | | |

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| 16 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Findsand | **M1** | 3.1a | 7th  Use numerical methods to solve problems in context. |
| Change of sign and continuous function in the interval root | **A1** | 2.4 |
|  | **(2)** |  |  |
| **(b)** | Makes an attempt to differentiate h(*t*) | **M1** | 2.2a | 7th  Use numerical methods to solve problems in context. |
| Correctly finds | **A1** | 1.1b |
| Findsand | **M1** | 1.1b |
| Attempts to find | **M1** | 1.1b |
| Finds | **A1** | 1.1b |
|  | **(5)** |  |  |
| **(c)** | Demonstrates an understanding that *x* = 19.3705 and *x* = 19.3715 are the two values to be calculated. | **M1** | 2.2a | 7th  Use numerical methods to solve problems in context. |
| Findsand | **M1** | 1.1b |
| Change of sign and continuous function in the interval root | **A1** | 2.4 |
|  | **(3)** |  |  |
| (10 marks) | | | | |
| Notes  **(a)** Minimum required is that answer states there is a sign change in the interval and that this implies a root in the given interval. | | | | |

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| 17 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Demonstrates an attempt to find the vectors,and | **M1** | 2.2a | 6th  Solve geometric problems using vectors in 3 dimensions. |
| Finds,and | **A1** | 1.1b |
| Demonstrates an attempt to find,and | **M1** | 2.2a |
| Finds  Finds  Finds | **A1** | 1.1b |
| Demonstrates an understanding of the need to use the Law of Cosines. Either  (or variation) is seen, or attempt to substitute into formula is made | **M1 ft** | 2.2a |
| Makes an attempt to simplify the above equation. For example,  is seen. | **M1 ft** | 1.1b |
| Shows a logical progression to state | **B1** | 2.4 |
|  | **(7)** |  |  |
| **(b)** | States or implies thatis isosceles. | **M1** | 2.2a | 6th  Solve geometric problems using vectors in 3 dimensions. |
| Makes an attempt to find the missing angles | **M1** | 1.1b |
| States. Accept awrt 56.8° | **A1** | 1.1b |
|  | **(3)** |  |  |
| (10 marks) | | | | |
| Notes  **(b)** Award ft marks for a correct answer topart **a** using their incorrect answer from earlier inpart **a**. | | | | |