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| 1 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Makes an attempt to factor all the quadratics on the left-hand side of the identity. | **M1** | 2.2a | 5th  Simplify algebraic fractions. |
| Correctly factors each expression on the left-hand side of the identity: | **A1** | 2.2a |
| Successfully cancels common factors: | **M1** | 1.1b |
| States that | **M1** | 1.1b |
| States or implies that *A* = 2, *B* = −9 and *C* = −18 | **A1** | 1.1b |
| (5 marks) | | | | |
| Notes  Alternative method  Makes an attempt to substitute *x* = 0 (M1)  Finds *C* = −18 (A1)  Substitutes *x* = 1 to give *A* + *B* = −7 (M1)  Substitutes *x* = −1 to give *A* − *B* = 11 (M1)  Solves to get *A* = 2, *B* = −9 and *C* = −18 (A1) | | | | |

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| 2 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Begins the proof by assuming the opposite is true.  ‘Assumption: there exists a number *n* such that *n2* is even and *n* is odd.’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Defines an odd number (choice of variable is not important) and successfully calculates *n2*  Let 2*k +* 1 be an odd number. | **M1** | 2.2a |
| Factors the expression and concludes that this number must be odd.  , so *n*2 is odd. | **M1** | 1.1b |
| Makes a valid conclusion.  This contradicts the assumption *n*2 is even. Therefore if *n*2 is even, *n* must be even. | **B1** | 2.4 |
|  | **(4)** |  |  |

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| **(b)** | Begins the proof by assuming the opposite is true.  ‘Assumption:is a rational number.’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Defines the rational number:  for some integers *a* and *b*, where *a* and *b* have no common factors. | **M1** | 2.2a |
| Squares both sides and concludes that *a* is even:    From part **a**: *a*2 is even implies that *a* is even. | **M1** | 1.1b |
| Further states that if *a* is even, then *a =* 2*c*. Choice of variable is not important. | **M1** | 1.1b |
| 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** | 1.1b |
| 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** | 2.4 |
|  | **(6)** |  |  |
| (10 marks) | | | | |
| **Notes** | | | | |

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| 3 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Correctly states that | **M1** | 2.2a | 6th  Understand the binomial theorem for rational n. |
| Simplifies to obtain … | **M1** | 1.1b |
| Deduces that | **M1** | 2.2a |
| Solves to find | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(b)** | . Award mark for –500 seen. | **A1** | 1.1b | 6th  Understand the binomial theorem for rational n. |
| . Award mark for 500 seen. | **A1** | 1.1b |
|  | **(2)** |  |  |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 4 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | States | **M1** | 3.1b | 5th  Differentiate simple trigonometric functions. |
| Makes correct substitutions: | **M1** | 1.1b |
| Uses the appropriate trigonometric addition formula to write | **M1** | 2.2a |
| Groups the terms appropriately | **A1** | 2.2a |
|  | **(4)** |  |  |
| **(b)** | Explains that as *h* → 0,and | **M1** | 3.2b | 5th  Differentiate simple trigonometric functions. |
| Concludes that this leaves  So if | **A1** | 3.2b |
|  | **(2)** |  |  |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 5 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Makes an attempt to find. Raising the power by 1 would constitute an attempt. | **M1** | 1.1b | 6th  Integrate using the reverse chain rule. |
| Correctly states | **A1** | 2.2a |
| States | **M1 ft** | 1.1b |
| Makes an attempt to solve this equation. For example,oris seen. | **M1 ft** | 1.1b |
| Solves to find | **A1 ft** | 1.1b |
| (5 marks) | | | | |
| Notes  Student does not need to state ‘+C’ in an answer unless it is the final answer to an indefinite integral.  Award ft marks for a correct answer using an incorrect initial answer. | | | | |

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| 6 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Rearranges to find | **M1** | 1.1b | 5th  Understand the concept of roots of equations. |
| Statesand thereforeandor states | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(b)** | Attempts to use iterative procedure to find subsequent values. | **M1** | 1.1b | 6th  Solve equations approximately using the method of iteration. |
| Correctly finds: | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(c)** | Demonstrates an understanding that the two values of f(*x*) to be calculated are for *x* = –2.7815 and *x* = –2.7825. | **M1\*** | 2.2a | 5th  Use a change of sign to locate roots. |
| Finds and | **M1** | 1.1b |
| Change of sign and continuous function in the interval root | **A1** | 2.4 |
|  | **(3)** |  |  |
| (7 marks) | | | | |
| Notes  **(b)** Award M1 if finds at least one correct answer.  **(c)** 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. | | | | |

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| 7 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Makes an attempt to find . For example, writing | **M1** | 2.2a | 5th  Find composite functions. |
| Uses the law of logarithms to write | **M1** | 1.1b |
| States that | **A1** | 1.1b |
| States that the range is  or | **B1** | 3.2b |
|  | **(4)** |  |  |
| **(b)** | States that | **M1** | 1.1b | 5th  Find the domain and range of composite functions. |
| Makes an attempt to solve for *x*, including attempting to take the square root of both sides of the equation. For example, | **M1** | 1.1b |
| States that *x* = 8. Does not need to state that , but do not award the mark if *x* = −10 is stated. | **A1** | 3.2b |
|  | **(3)** |  |  |
| (7 marks) | | | | |
| **Notes** | | | | |

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| 8 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Forms a pair of simultaneous equations, using the given values | **M1** | 2.2a | 4th  Understand simple arithmetic sequences. |
| Correctly solves to find *d* = −6 | **A1** | 1.1b |
| Finds *a* = 116 | **A1** | 1.1b |
| Uses  to find | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(b)** | Uses the sum of an arithmetic series to form the equation | **M1 ft** | 2.2a | 5th  Understand simple arithmetic series. |
| Successfully multiplies out the brackets and simplifies. Fully simplified quadratic of  is seen or is seen. | **M1 ft** | 1.1b |
| Correctly factorises: | **M1 ft** | 1.1b |
| States that *n* = 39 is the correct answer. | **A1** | 1.1b |
|  | **(4)** |  |  |
| (8 marks) | | | | |
| Notes  **(a)** Can use elimination or substitution to solve the simultaneous equations.  **(b)** Award method marks for a correct attempt to solve the equation using their incorrect values from part **a**. | | | | |

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| 9 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States thatand concludes that | **M1** | 3.1 | 6th  Prove  sec2*x* = 1 + tan2*x* and  cosec2*x* = 1 + cot2*x.* |
| States thatand concludes that | **M1** | 3.1 |
| States that | **M1** | 2.2a |
| States thatand concludes thatoe. | **M1** | 3.1 |
| States thatand concludes thatoe. | **M1** | 3.1 |
| Recognises the need to use Pythagoras’ theorem. For example, | **M1** | 2.2a |
| Makes substitutions and begins to manipulate the equation: | **M1** | 1.1b |
| Uses a clear algebraic progression to arrive at the final answer: | **A1** | 1.1b |
| (8 marks) | | | | |
| **Notes** | | | | |

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| 10 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Makes an attempt to find the resultant force by adding the three force vectors together. | **M1** | 3.1a | 6th  Solve contextualised problems in mechanics using 3D vectors. |
| Finds | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(b)** | States  or writes | **M1** | 3.1a | 6th  Solve contextualised problems in mechanics using 3D vectors. |
| Finds | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(c)** | Demonstrates an attempt to find  For example, | **M1** | 3.1a | 6th  Solve contextualised problems in mechanics using 3D vectors. |
| Findsm s−2 | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(d)** | States | **M1** | 3.1a | 6th  Solve contextualised problems in mechanics using 3D vectors. |
| Makes an attempt to substitute values into the equation. | **M1 ft** | 1.1b |
| Findsm | **A1 ft** | 1.1b |
|  | **(3)** |  |  |
| (9 marks) | | | | |
| Notes  **(d)** Award ft marks for a correct answer topart **d** using their incorrect answer frompart **c**. | | | | |

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| 11 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Equating the coefficients of *x*4: *A* = 5 | **A1** | 2.2a | 6th  Solve problems using the remainder theorem linked to improper algebraic fractions. |
| Equating the coefficients of *x*3: *B* = −4 | **A1** | 1.1b |
| Equating the coefficients of *x*2: 2*A* + *C* = 17, *C* = 7 | **A1** | 1.1b |
| Equating the coefficients of *x*: 2*B* + *D* = −5, *D* = 3 | **A1** | 1.1b |
| Equating constant terms: 2*C* + *E* = 7, *E* = −7 | **A1** | 1.1b |
| (5 marks) | | | | |
| **Notes** | | | | |

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| 12 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | States that | **M1** | 1.1b | 6th  Decompose algebraic fractions into partial fractions − linear factors. |
| Equates the various terms.  Equating *x*s  Equating numbers | **M1** | 1.1b |
| Multiplies or or both of the equations in an effort to equate one of the two variables. | **M1** | 1.1b |
| Finds *A* = 5 | **A1** | 1.1b |
| Find *B* = 6 | **A1** | 1.1b |
|  | **(5)** |  |  |
| **(b)** | Writes as | **M1 ft** | 2.2a | 6th  Integrate functions using the reverse chain rule. |
| Makes an attempt to integrate the expression. Attempt would constitute the use of logarithms. | **M1 ft** | 2.2a |
| Integrates the expression to find | **A1 ft** | 1.1b |
| Makes an attempt to substitute the limits | **M1 ft** | 1.1b |
| Simplifies to findo.e. | **A1 ft** | 1.1b |
|  | **(5)** |  |  |
| (10 marks) | | | | |
| Notes  Award ft marks for a correct answer to part **b** using incorrect values from part **a**. | | | | |

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| 13 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Shows or implies that if *y* = 0, *t* = 1 | **M1** | 1.1b | 7th  Solve coordinate geometry problems involving parametric equations. |
| Finds the coordinates of *P*. | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(b)** | Attempts to find a cartesian equation of the curve. For example, *t* = *x* − 2 is substituted into | **M1** | 2.2a | 7th  Solve coordinate geometry problems involving parametric equations. |
| Correctly finds the cartesian equation of the curveAccept any equivalent answer. For example, | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(c)** | Finds | **M1** | 2.2a | 7th  Solve coordinate geometry problems involving parametric equations. |
| Substitutes *t* = −1 to find *x* = 1 and | **M1** | 1.1b |
| Finds the gradient of the normal | **M1** | 1.1b |
| Substitutes *t* = −1 to find *x* = 1 and *y* = −2 | **A1** | 1.1b |
| Makes an attempt to find the equation of the normal. For example, is seen. | **M1** | 1.1b |
| States fully correct answer | **A1** | 1.1b |
|  | **(6)** |  |  |

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| **(d)** | Substitutesandintoobtaining | **M1 ft** | 2.2a | 7th  Solve coordinate geometry problems involving parametric equations. |
| Manipulates and simplifies this equation to obtain | **M1 ft** | 1.1b |
| Factorises and solves to find *t* = −1 or *t* = −11 | **M1 ft** | 1.1b |
| Substitutes *t* = −11 to find *x* = −9 and , i.e. | **A1 ft** | 1.1b |
|  | **(4)** |  |  |
| (14 marks) | | | | |
| Notes  **(c)** Award ft marks for correct answer using incorrect values from part **b**. | | | | |