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| 1 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States that: | **M1** | 2.2a | 7th  Decompose algebraic fractions into partial fractions − repeated factors. |
| Further states that: | **M1** | 1.1b |
| Equates the various terms.  Equating the coefficients of *x*2:  Equating the coefficients of *x*:  Equating constant terms: | **M1** | 2.2a |
| Makes an attempt to manipulate the expressions in order to find *A*, *B* and *C*. Obtaining two different equations in the same two variables would constitute an attempt. | **M1** | 1.1b |
| Finds the correct value of any one variable:  either *A* = 4, *B* = −2 or *C* = 6 | **A1** | 1.1b |
| Finds the correct value of all three variables:  *A* = 4, *B* = −2, *C* = 6 | **A1** | 1.1b |
| (6 marks) | | | | |
| Notes  Alternative method  Uses the substitution method, having first obtained this equation:  Substitutes *x* = 4 to obtain 13*B* = −26  Substitutes  to obtain  Equates the coefficients of *x*2:  Substitutes the found value of *C* to obtain 3*A* = 12 | | | | |

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| 2 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Differentiates 4*x* to obtain 4*x* ln 4 | **M1** | 1.1b | 7th  Differentiate simple functions defined implicitly. |
| Differentiates 2*xy* to obtain | **M1** | 2.2a |
| Rearrangesto obtain | **A1** | 1.1b |
| Makes an attempt to substitute (2, 4) | **M1** | 1.1b |
| States fully correct final answer:  Accept | **A1** | 1.1b |
| (5 marks) | | | | |
| **Notes** | | | | |

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| 3 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Correctly states | **M1** | 1.1b | 6th  Integrate using trigonometric identities. |
| Correctly states    or states | **M1** | 1.1b |
| Adds the two above expressions and states | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(b)** | States that | **M1** | 2.2a | 6th  Integrate functions of the form f(*ax* + *b*). |
| Makes an attempt to integrate. Changing cos to sin constitutes an attempt. | **M1** | 1.1b |
| Correctly states the final answero.e. | **A1** | 1.1b |
|  | **(3)** |  |  |
| (6 marks) | | | | |
| Notes  **(b)** Student does not need to state ‘+C’ to be awarded the first method mark. Must be stated in the final answer. | | | | |

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| 4 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Makes an attempt to substitute *t* = 0 into. For example, or  is seen. | **M1** | 3.1a | 6th  Set up and use exponential models of growth and decay. |
| Concludes that the *TR* terms will always cancel at *t* = 0, therefore the room temperature does not influence the initial coffee temperature. | **B1** | 3.5a |
|  | **(2)** |  |  |
| **(b)** | Makes an attempt to substitute  and *t* = 10 into . For example, is seen. | **M1** | 1.1b | 6th  Set up and use exponential models of growth and decay. |
| Finds. Accept awrt 62.5°. | **A1** | 1.1b |
|  | **(2)** |  |  |
| (4 marks) | | | | |
| **Notes** | | | | |

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| 5 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Begins the proof by assuming the opposite is true.  ‘Assumption: there exists a number *n* such that *n* is odd and  *n*3 *+* 1 is also odd.’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Defines an odd number.  ‘Let 2*k +* 1 be an odd number.’ | **B1** | 2.2a |
| Successfully calculates | **M1** | 1.1b |
| Factors the expression and concludes that this number must be even.    is even. | **M1** | 1.1b |
| Makes a valid conclusion.  This contradicts the assumption that there exists a number *n* such that *n* is odd and *n*3 *+* 1is also odd, so if *n* is odd, then  *n*3 *+* 1 is even. | **B1** | 2.4 |
| (5 marks) | | | | |
| Notes  Alternative method  Assume the opposite is true: there exists a number *n* such that *n* is odd and *n3 +* 1 is also odd. (**B1**)  If *n*3 *+* 1 is odd, then *n*3 is even. (**B1**)  So 2 is a factor of *n*3. (**M1**)  This implies 2 is a factor of *n*. (**M1**)  This contradicts the statement *n* is odd. (**B1**) | | | | |

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| 6 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Recognises that the identity can be used to find the cartesian equation. | **M1** | 2.2a | 6th  Convert between parametric equations and cartesian forms using trigonometry. |
| Statesor  Also states | **M1** | 1.1b |
| Substitutesandinto | **M1** | 1.1b |
| Solves to find, accept *x* < 1 or | **A1** | 1.1b |
| (4 marks) | | | | |
| Notes | | | | |

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| 7 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Understands that for the series to be convergent  or states | **M1** | 2.2a | 6th  Understand convergent geometric series and the sum to infinity. |
| Correctly concludes that . Accept | **A1** | 1.1b |
|  | **(2)** |  |  |
| **(b)** | Understands to use the sum to infinity formula. For example, states | **M1** | 2.2a | 5th  Understand sigma notation. |
| Makes an attempt to solve for *x*. For example,  is seen. | **M1** | 1.1b |
| States | **A1** | 1.1b |
|  | **(3)** |  |  |
| (5 marks) | | | | |
| Notes | | | | |

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| 8 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Finds and | **M1** | 1.1b | 5th  Use a change of sign to locate roots. |
| Change of sign and continuous function in the interval root | **A1** | 2.4 |
|  | **(2)** |  |  |
| **(b)** | Makes an attempt to differentiate f(*x*) | **M1** | 2.2a | 6th  Solve equations approximately using the Newton-Raphson method. |
| Correctly finds | **A1** | 1.1b |
| Finds and | **M1** | 1.1b |
| Attempts to find | **M1** | 1.1b |
| Finds | **A1** | 1.1b |
|  | **(5)** |  |  |
| (7 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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| 9 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States and | **M1** | 2.2a | 6th  Solve geometric problems using vectors in 3 dimensions |
| Makes an attempt to solve the pair of simultaneous equations. Attempt could include making a substitution or multiplying the first equation by 5 or by 7. | **M1** | 1.1b |
| Finds *a* = −4 | **A1** | 1.1b |
| Find *b* = 6 | **A1** | 1.1b |
| States −2*abc* = −96 | **M1** | 2.2a |
| Finds *c* = −2 | **A1** | 1.1b |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 10 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Begins the proof by assuming the opposite is true.  ‘Assumption: there exist positive integer solutions to the statement’ | **B1** | 3.1 | 7th  Complete proofs using proof by contradiction. |
| Sets up the proof by factorising  and stating | **M1** | 2.2a |
| States that there is only one way to multiply to make 1:    and concludes this means that: | **M1** | 1.1b |
| Solves this pair of simultaneous equations to find the values of *x* and *y*: *x* = 1 and *y* = 0 | **M1** | 1.1b |
| Makes a valid conclusion.  *x =* 1, *y =* 0 are not both positive integers, which is a contradiction to the opening statement. Therefore there do not exist positive integers *x* and *y* such that | **B1** | 2.4 |
| (5 marks) | | | | |
| **Notes** | | | | |

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| 11 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Understands the need to complete the square, and makes an attempt to do this. For example, is seen. | **M1** | 2.2a | 6th  Find the domain and range of inverse functions. |
| Correctly writes | **A1** | 1.1b |
| Demonstrates an understanding of the method for finding the inverse is to switch the *x* and *y*. For example, is seen. | **B1** | 2.2a |
| Makes an attempt to rearrange to make *y* the subject. Attempt must include taking the square root. | **M1** | 1.1b |
| Correctly states | **A1** | 1.1b |
| Correctly states domain is *x* > −9 and range is *y* > 4 | **B1** | 3.2b |
| (6 marks) | | | | |
| Notes | | | | |

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| 12 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | States that: | **M1** | 2.2a | 6th  Decompose algebraic fractions into partial fractions − three linear factors. |
| Further states that: | **M1** | 1.1b |
| Equates the various terms.  Equating the coefficients of *x*2:  Equating the coefficients of *x*:  Equating constant terms: | **M1\*** | 2.2a |
| Makes an attempt to manipulate the expressions in order to find *A*, *B* and *C*. Obtaining two different equations in the same two variables would constitute an attempt. | **M1\*** | 1.1b |
| Finds the correct value of any one variable:  either *A* = 2, *B* = 5 or *C* = −1 | **A1\*** | 1.1b |
| Finds the correct value of all three variables:  *A* = 2, *B* = 5, *C* = −1 | **A1** | 1.1b |
| (6 marks) | | | | |
| Notes  Alternative method  Uses the substitution method, having first obtained this equation:  Substitutes *x* = 4 to obtain 9*B* = 45 (**M1**)  Substitutes *x* = 3 to obtain 8*A* = 16 (**M1**)  Substitutes *x* = −5 to obtain −72*C* = 72 (**A1**) | | | | |

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| 13 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Finds | **M1** | 1.1b | 7th  Use second derivatives to solve problems of concavity, convexity and points of inflection. |
| Finds | **M1** | 1.1b |
| States thatfor alland concludes this implies *C* is concave over the given interval. | **B1** | 3.2a |
|  | **(3)** |  |  |
| **(b)** | States or implies that a point of inflection occurs when | **M1** | 3.1a | 7th  Use second derivatives to solve problems of concavity, convexity and points of inflection. |
| Finds *x* = −2 | **A1** | 1.1b |
| Substitutes *x* = −2 into, obtaining *y* = 46 | **A1** | 1.1b |
|  | **(3)** |  |  |
| (6 marks) | | | | |
| **Notes** | | | | |

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| 14 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
|  | Makes an attempt to find. Raising the power by 1 would constitute an attempt. | **M1** | 2.2a | 6th  Integrate using the reverse chain rule. |
| States a fully correct answer | **M1** | 2.2a |
| Makes an attempt to substitute the limits | **M1 ft** | 1.1b |
| Correctly states answer is | **A1 ft** | 1.1b |
| (4 marks) | | | | |
| Notes  Student does not need to state ‘+C’ to be awarded the second method mark.  Award ft marks for a correct answer using an incorrect initial answer. | | | | |

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| 15 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | Makes an attempt to set up a long division. For example,  is seen. | **M1** | 2.2a | 7th  Expand rational functions using partial fraction decomposition. |
| Long division completed so that a 2 is seen in the quotient and a remainder of –2*x* – 7 is also seen. | **M1** | 1.1b |
| States | **M1** | 2.2a |
| Either equates variables or makes a substitution in an effort to find *B* or *C*. | **M1** | 2.2a |
| Finds | **A1** | 1.1b |
| Finds | **A1** | 1.1b |
|  | **(6)** |  |  |
| **(b)** | Correctly writes  or  as | **M1 ft** | 2.2a | 6th  Understand the binomial theorem for rational n. |
| Simplifies to obtain | **A1 ft** | 1.1b |
| Correctly writes  as | **M1 ft** | 2.2a |
| Correctly writes  as | **M1 ft** | 2.2a |
| Simplifies to obtain | **A1 ft** | 1.1b |
| States the correct final answer: | **A1 ft** | 1.1b |
|  | **(6)** |  |  |
| **(c)** | The expansion is only valid for | **B1** | 3.2b | 6th  Understand the conditions for validity of the binomial theorem for rational n. |
|  | **(1)** |  |  |
| (13 marks) | | | | |
| Notes  **(a) Alternative method.**  Writes the RHS as a single fraction.    **(b)** Award all 6 marks for a correct answer using their incorrect values of *A*, *B* and/or *C* from part **a**. | | | | |

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| 16 | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **(a)** | States | **M1** | 3.1b | 8th  Solve differential equations in a range of contexts. |
| Deduces that | **M1** | 3.1b |
| Findsand/or | **M1** | 1.1b |
| States | **M1** | 3.1b |
| Makes an attempt to find | **M1** | 1.1b |
| Shows a clear logical progression to state | **A1** | 1.1b |
|  | **(6)** |  |  |
| **(b)** | Separates the variables | **M1** | 2.2a | 8th  Solve differential equations in a range of contexts. |
| Finds | **A1** | 1.1b |
| Uses the fact that *t* = 0 when *h* = 50 m to find *C* | **M1** | 1.1b |
| Substitutes *h =* 60 into the equation | **M1** | 3.1b |
| Uses law of logarithms to write | **M1** | 2.2a |
| States correct final answerminutes. | **A1** | 1.1b |
|  | **(6)** |  |  |
| (12 marks) | | | | |
| Notes | | | | |