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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1** |  | **B1**  **M1**  **A1**  **M1**  **A1**  **A1**  **A1** | 9.1  9.1  9.1  9.1  9.1  9.2  9.2 | 5th  Find particular solutions to first order differential equations using an integrating factor |
| (7 marks) | | | | |
| Notes  **B1** Rearranges equation  **M1** Use of integrating factor  **A1** Correct IF  **M1** Multiplies by IF  **A1** Integrates  **A1** Evaluates c  **A1** cao | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **2** |  | **M1**  **A1**  **A1**  **B1** | 9.4  9.4  9.6  9.6 | 5th  Solve second order homogeneous differential equations using the auxiliary equation |
| (4 marks) | | | | |
| Notes  **M1** Use of auxilary equation  **A1** Solves correctly  **A1** Correct power  **B1** (A*x* + B) | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **3** | C.F.          P.I. Try                General solution      Substituting        Solution is | **M1**  **A1**  **A1**  **M1**  **A1**  **A1**  **A1**  **M1**  **A1**  **A1**  **A1** | 9.6  9.6  9.6  9.6  9.6  9.6  9.6  9.6  9.6  9.6  9.6 | 6th  Solve second order non-homogeneous differential equations using a particular integral |
| **(11 marks)** | | | | |

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| Notes  **M1** Use of auxilary equation  **A1** Solves correctly  **A1** C.F. correct  **M1** Correct form for P.I.  **A1** First differential correct  **A1** Second differential correct  **A1** Substitutes and solves for k  **M1** Attempts general solution  **A1** Differentiates  **A1** Forms simultaneous equations  **A1** cao |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **4ai** | Substituting | **M1**  **A1**  **A1** | 9.6  9.6  9.6 | 6th  Solve second order non-homogeneous differential equations using a particular integral |
|  | **(3)** |  |  |
| **4aii** | C.F.    General solution | **M1**  **A1**  **A1**  **A1**  **B1** | 9.6  9.6  9.6  9.3  9.3 | 6th  Solve second order non-homogeneous differential equations using a particular integral |
|  | **(5)** |  |  |

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| **4b** |  | **M1**  **M1**  **A1**  **A1** | 9.3  9.3  9.3  9.3 | 6th  Solve second order non-homogeneous differential equations using a particular integral |
|  | **(4)** |  |  |
| **4c** | So the mass will oscillate (with amplitude ) it tends to SMH | **B1** | 9.3 | 8th  Model damped oscillations with a forced vibration using second order differential equations and interpret their solutions |
|  | **(1)** |  |  |
| (13 marks) | | | | |

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| Notes  **4ai M1** Attempts to differentiate  **A1** First and second differentials correct  **A1** cao (A.G.)  **4aii M1** Auxiliary equation used  **A1** Use of quadratic formula  **A1** cao  **A1** C.F. correct  **B1** General solution correct  **4b M1** Differentiates  **M1** Substitutes values  **A1** Solves for A and B  **A1** cao  **4c B1** Shows that the mass tends to simple harmonic motion or an oscillation with constant amplitude and period. |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **5a** |  | **M1**  **A1**  **A1\*** | 9.9  9.9  9.9 | 8th  Solve pairs of coupled first order differential equations and interpret the models in context |
|  | **(3)** |  |  |
| **5b** | Initially    Substituting | **M1**  **A1**  **M1**  **A1**  **A1** | 9.4  9.4  9.6  9.6  9.6 | 8th  Solve pairs of coupled first order differential equations and interpret the models in context |
|  | **(5)** |  |  |

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| **5c** |  | **M1**  **M1**  **A1**  **A1** | 9.1  9.1  9.1  9.1 | 8th  Solve pairs of coupled first order differential equations and interpret the models in context |
|  | **(4)** |  |  |
| **5d** | Therefore 35.67 years or 35 years 8 months | **M1**  **A1**  **B1** | 9.9  9.9  9.9 | 8th  Solve pairs of coupled first order differential equations and interpret the models in context |
|  | **(3)** |  |  |
| (15 marks) | | | | |

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| Notes  **5a M1** Differentiates  **A1** Substitutes  **A1\*** Correct simplification (A.G.)  **5b M1** Attempts to solve auxiliary equation  **A1** General solution for *x*  **M1** Differentiates  **A1** Correct initial condition  **A1** Solves for A and B  **5c M1** Rearranges the given expression.  **M1** Differentiates their expression for *x* and attempts to substitute  **A1** Correct unsimplified substitution  **A1** Correct solution for *y*  **5d M1** Attempts to solve equation  **A1**cao for *t*  **B1** cao for *x* |