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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1** |  | **B1****M1****A1****M1****A1****A1****A1** | 9.19.19.19.19.19.29.2 | 5thFind 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** | 9.49.49.69.6 | 5thSolve 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. TryGeneral solutionSubstitutingSolution is | **M1****A1****A1****M1****A1****A1****A1****M1****A1****A1****A1** | 9.69.69.69.69.69.69.69.69.69.69.6 | 6thSolve 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** | 9.69.69.6 | 6thSolve second order non-homogeneous differential equations using a particular integral |
|  | **(3)** |  |  |
| **4aii** | C.F.General solution | **M1****A1****A1****A1****B1** | 9.69.69.69.39.3 | 6thSolve second order non-homogeneous differential equations using a particular integral |
|  | **(5)** |  |  |

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| **4b** |  | **M1****M1****A1****A1** | 9.39.39.39.3 | 6thSolve 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 | 8thModel 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\*** | 9.99.99.9 | 8thSolve pairs of coupled first order differential equations and interpret the models in context |
|  | **(3)** |  |  |
| **5b** | InitiallySubstituting | **M1****A1****M1****A1****A1** | 9.49.49.69.69.6 | 8thSolve pairs of coupled first order differential equations and interpret the models in context |
|  | **(5)** |  |  |

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| **5c** |  | **M1****M1****A1****A1** | 9.19.19.19.1 | 8thSolve 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** | 9.99.99.9 | 8thSolve 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* |