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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **1** | States or implies   and | **M1** | 1.1b | 5th  Solve coordinate geometry problems involving lines in three dimensions |
| Writes | **M1** | 2.2a |
| Simplfies to obtain | **M1** | 1.1b |
| Reduces and factorises: | **M1** | 1.1b |
| Finds  and states | **A1** | 1.1b |
| Finds  and states | **A1** | 1.1b |
| (6 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **2** | Demonstrates an understanding of perpendicular vectors  For example,  states or , or states scalar product is zero | **M1** | 3.1a | 5th  Solve coordinate geometry problems involving lines in three dimensions |
| Writes two vector equations,  and | **M1** | 1.1b |
| Makes an attempt to solve these equtions by setting either *x*, *y* or *z* equal to a constant, most likely 1 | **M1** | 2.2a |
| Solves to find *x*, *y* or *z* and states the solution:  or a multiple thereof | **A1** | 1.1b |
| (4 marks) | | | | |
| Notes  Some may use cross or vector product to do this question. | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **3** | Finds any two vectors  For example,  and | **M1** | 3.1a | 5th  Use the scalar product to solve coordinate geometry problems in three dimensions |
| Finds the scalar product of these two vectors, | **M1** | 1.1b |
| Finds the magnitude of each vector,  and | **M1** | 1.1b |
| Uses  to find  and therefore | **A1** | 2.2a |
| States area =  or writes, area = | **M1** | 2.2a |
| States correct answer = 71.0, accept awrt 71.0 | **A1** | 1.1b |
| (6 marks) | | | | |
| Notes  Some may use vector product  The triangle area is | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **4a** | Demonstrates an understanding of perpendicular vectors by writing, | **M1** | 3.1a | 5th  Solve coordinate geometry problems involving lines in three dimensions |
| Solves  writing | **A1** | 1.1b |
|  | **(2)** |  |  |
| **4b** | Writes any two of the following by equating *x*, *y* and *z* compnents,  or | **M1** | 3.1a | 5th  Solve coordinate geometry problems involving lines in three dimensions |
| Solves any pair of simultaneous equations to find,  and | **M1** | 1.1b |
| Checks that  and  satisfies the third equation | **M1** | 2.3 |
| States the correct point of intersection, | **A1** | 1.1b |
|  | **(4)** |  |  |
| (6 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **5** | States that a general point on  has position vector | **M1** | 1.1b | 6th  Find the point of intersection of a line and a plane |
| Makes an attempt to substitute  into  For example,  is seen | **M1** | 3.1a |
| Solves the equation to find  and concludes that the point of intersection is | **M1** | 1.1b |
| States that a vector equation of the line through  and perpendicular to  is | **M1** | 3.1a |
| Attempts to finds a point on this line that is also on  by substituting,  and  into | **M1** | 3.1a |
| Solves  to obtain | **A1** | 1.1b |
| Concludes that the point,    is halfway between  and a point on ; therefore, a point on  has position vector,    (continued) | **M1** | 3.2a |

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|  | Attempts to find the equation of  using the points  and | **M1** | 1.1b |  |
| Finds a correct vector equation of  :  Accept  instead of  and any multiple of | **A1** | 1.1b |
| (9 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **6a** | Finds two vectors in the plane, for example  and | **M1** | 3.1a | 5th  Use the scalar product to find normal vectors |
| Uses the dot product to find two vector equations,  and | **M1** | 1.1b |
| Makes an attempt to solve these equations by setting either *x*, *y* or *z* equal to a constant, most likely 1 | **M1** | 2.2a |
| Solves to find *x*, *y* or *z* and states the solution for a vector normal to the plane,  or  or a multiple thereof | **A1** | 2.2a |
| Finds a unit vector normal to the plane using Pythagoras’ Theorem in three dimensions, | **A1** | 1.1b |
|  | **(5)** |  |  |
| **6b** | Uses the fact that a general vector on the plane  will be perpendicular to the normal vector  by writing | **M1** | 3.1a | 5th  Find the Cartesian equation of a plane in three dimensions |
| Solves to find: | **A1** | 1.1b |
|  | **(2)** |  |  |

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| **6c** | States  and  and finds the scalar product of these two vectors, | **M1** | 1.1b | 6th  Find angles between lines and planes in three dimensions |
| Finds the magnitude of each vector,  and | **M1** | 1.1b |
| Uses  to find  and finds | **M1** | 2.2a |
| States the acute angle between the planes is | **A1** | 1.1b |
|  | **(4)** |  |  |
| (11 marks) | | | | |
| Notes | | | | |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress Descriptor |
| **7a** | Finds | **M1** | 3.1a | 7th  Find the shortest distance between a point and a line |
| States that a general point, *S*, on  is | **M1** | 1.1b |
| At the shortest (perpendicular) distance | **M1** | 1.1b |
| Solves  to obtain | **A1** | 1.1b |
| Substitutes  to find the coordinates of *S*:  and attempts to find the distance | **M1** | 3.1a |
| Finds minimum distance = | **A1** | 1.1b |
| Concludes that as this is greater than 15 km, so submarine A can move undetected. | **A1 ft** | 3.2a |
|  | **(7)** |  |  |
| **7b** | Possible answers,  Sub A will not move in an exact straight line  Sub A might purposely deviate to avoid detection  Sub A might not be able to move in a straight line due to rocks  Sub B will not be stationary | **B1** | 3.5b | 7th  Find the shortest distance between a point and a line |
|  | **(1)** |  |  |
| (8 marks) | | | | |
| Notes | | | | |