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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **1a** | States correct answer: 5.3 (m s−1) | **B1** | 2.2a | 4th  Understand the difference between a scalar and a vector. |
|  | **(1)** |  |  |
| **1b** | States correct answer: −4.8 (m s−1) | **B1** | 2.2a | 4th  Understand the difference between a scalar and a vector. |
|  | **(1)** |  |  |
| **1c** | States correct answer: −30 (m) | **B1** | 2.2a | 4th  Understand the difference between a scalar and a vector. |
|  | **(1)** |  |  |
| **(3 marks)** | | | | |
| **Notes** | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **2ai** | States that *x* = 0 needs to be substituted or implies it by writing | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Correctly substitutes *x* = 0 to get *h* = 1.7 (m) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2aii** | States that *x* = 7 needs to be substituted or implies it by writing *h* = 1.7 + 0.18(7) – 0.01(7)2 | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Correctly substitutes *x* = 7 to get *h* = 2.47 (m)  Accept awrt 2.5 (m) | **A1** | 1.1b |
|  | **(2)** |  |  |
| **2b** | Understands that the ball will hit the ground when *h* = 0 or writes | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Realises that the quadratic formula is needed to solve the quadratic. For example *a* = 0.01, *b* =  *c* =  seen, or makes attempt to use the formula: | **M1** | 1.1b |
| Simplifies the  part to get 0.1004 or shows | **M1** | 1.1b |
| Calculates *x* = 24.84… (m)  Accept awrt 24.8 (m)  Does not need to show that (m) | **A1** | 1.1b |
| States that the ball will be called ‘in’, or says, for example, yes as 24.84… < 25. | **B1** | 3.2a |
|  | **(5)** |  |  |

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| **2c** | Award 1 method mark for multiplication by 1000 and 1 method mark for division by 60. | **M2** | 1.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| 33.3 (m s−1) or (m s−1) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **(12 marks)** | | | | |
| **Notes**  **2ai**  Award both marks for a correct final answer.  **2aii**  Award both marks for a correct final answer.  **2b**  is also acceptable.  **2b**  Award the third method mark even if this step is not seen, providing the final answer is correct. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **3a** | Understands that the pole vaulter will land when *h* = 0 or writes | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Correctly factorises to get o.e. | **M1** | 1.1b |
| Solves to get (m)  Accept awrt 10.4 (m) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **3b** | States that the greatest height will occur when *x* = 5.20…(m) | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Makes an attempt to substitute *x* = 5.20…into the equation for *h*. For example, seen. | **M1** | 1.1b |
| *h* = 5.42…(m)  Accept awrt 5.4 (m) | **A1 ft** | 1.1b |
|  | **(3)** |  |  |
| **3c** | States *h* = 4.9 or states that | **M1** | 3.1b | 3rd  Understand how mechanics problems can be modelled mathematically. |
| Simplifies this to reach  o.e. | **M1** | 1.1b |
| Realises that the quadratic formula is needed to solve the quadratic. For example  seen, or makes attempt to use the formula: | **M1** | 1.1b |
| Simplifies the  part to get 1513 or shows | **M1** | 1.1b |
| *x* = 6.82…(m)  Accept awrt 6.8 (m) | **A1** | 1.1b |
| *x* = 3.58… (m)  Accept awrt 3.6 (m) | **A1** | 1.1b |
| The pole vaulter can leave the ground between 3.6 m and 6.8 m from the bar. | **B1** | 3.2a |
|  | **(7)** |  |  |
| **3di** | Allows the person to be treated as a single mass and allows the effects of rotational forces to be ignored. | **B1** | 3.4 | 3rd  Understand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| **3dii** | The effects of air resistance can be ignored. | **B1** | 3.4 | 3rd  Understand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| **(15 marks)** | | | | |
| **Notes**  **3b**  For the first method mark, accept their answer to part **a** divided by 2. Continue to award marks for a correct answer using their initial incorrect value.  **3c**  Accept 3.6 ⩽ *x* ⩽ 6.8 | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **4a** | Makes an attempt to find the distance from *A* to *B*. For example, is seen. | **M1** | 3.1b | 4th  Find the magnitude and direction of a vector quantity. |
| Makes an attempt to find the distance from *B* to *C*. For example, is seen. | **M1** | 3.1b |
| Demonstrates an understanding that these two values need to be added. For example, 84.75… + 130.86… is seen. | **M1** | 1.1b |
| 215.62… (m)  Accept anything which rounds to 216 (m) | **A1** | 1.1b |
|  | **(4)** |  |  |
| **4b** | States that (m)  Award one point for each value. | **B2** | 3.1b | 4th  Find the magnitude and direction of a vector quantity. |
| States or implies that | **M1** | 1.1b |
| Finds  Accept awrt 43.0° | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(8 marks)** | | | | |
| **Notes** | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **5a** | Makes an attempt to find the absolute value. For example,  is seen. | **M1** | 3.1b | 4th  Find the magnitude and direction of a vector quantity. |
| Simplifies to | **M1** | 1.1b |
| Finds speed = 26.07… (ms−1)  Accept awrt 26.1 (ms−1) | **A1** | 1.1b |
|  | **(3)** |  |  |
| **5b** | States that | **M1** | 1.1b | 4th  Find the magnitude and direction of a vector quantity. |
| Finds the value of *θ*, *θ* = 57.52… | **A1** | 1.1b |
| Demonstrates that the angle with the unit **j** vector is  90 – 57.52… | **M1** | 1.1b |
| Finds 32.47… (°)  Accept awrt 32.5(°) | **A1** | 1.1b |
|  | **(4)** |  |  |
| **5c** | Ignore the value of friction between the hockey puck and the ice. | **B1** | 3.4 | 3rd  Understand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| **5d** | Award 1 method mark for division by 1000 and 1 method mark for multiplication by 100 only once and the final method mark for multiplication by 100 three times. | **M3** | 1.1b | 4th  Know derived quantities and SI units. |
| 1400 kg m−3 | **A1** | 1.1b |
|  | **(4)** |  |  |
| **(12 marks)** | | | | |
| **Notes**  **5b**  Award all 4 marks for a correct final answer. Award 2 marks for a student stating , and then either making a mistake with the inverse or subtracting that answer from 90. | | | | |