|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **1a** | Use of | **M1** | 1.1a | 6thResolve velocity into horizontal and vertical components. |
| Initial velocity is | **A1** | 3.4 |
|  | **A1** | 1.1b |
|  | **B1** | 1.1b |
|  | **(4)** |  |  |
| **1b** | Solve *y* = 0 for *t* | **M1** | 3.4 | 5thModel horizontal projection under gravity. |
|  | **A1** | 1.1b |
| *t* = 0 or | **A1** | 1.1b |
| *t* = 0 is initial position so | **M1** | 2.4 |
|  | **A1** | 1.1b |
|  | **(5)** |  |  |
| **1c** | Sketch of sin 2*θ* or other legitimate method. | **M1** | 2.2a | 6thResolve velocity into horizontal and vertical components. |
| Maximum is at *θ* = 45° | **A1** | 2.4 |
|  | **(2)** |  |  |
| **1d** | Correct limitation. For example, air resistance. | **B1** | 3.5b | 3rdUnderstand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| (12 marks) |
| Notes |
| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **2a** | Calculate initial velocities. | **M1** | 3.1a | 7thSolve problems in familiar contexts involving projectile motion. |
| Initial horizontal velocity(m s−1). | **A1** | 1.1b |
| Initial vertical velocity(m s−1). | **A1** | 1.1b |
| Use of suvat equations. | **M1** | 3.1a |
|  | **A1** | 1.1b |
|  | **A1** | 1.1b |
| Max occurs when | **M1** | 2.4 |
| (s) | **A1** | 1.1b |
| then *x* = 0.2 (m) | **A1** | 1.1b |
| and *y* = 0.1 (m) | **A1** | 1.1b |
|  | **(10)** |  |  |
| **2b** | Max height when hits wall. | **M1** | 3.1b | 8thSolve problems in unfamiliar contexts involving projectile motion. |
| Solve for *t.* | **M1** | 1.1b |
|  | **A1** | 1.1b |
| Substitute *t* into *y.* | **M1** | 1.1b |
| *y* = 0.075 m = 7.5 cm | **A1** | 3.2a |
|  | **(5)** |  |  |
| **2c** | Any valid limitation. For example, the ball bounces off the wall. | **B1** | 3.5b | 3rdUnderstand assumptions common in mathematical modelling. |
|  | **(1)** |  |  |
| (16 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **3** | Suvat equation. | **M1** | 3.1a | 8thDerive formulae for projectile motion. |
|  | **M1** | 1.1b |
| (allow awrt 6.9) | **A1** | 1.1b |
| Solve *y* = 2 | **M1** | 1.1a |
| *t* = 0.404… or *t* = 1.009… (accept awrt 0.40 and 1.01) | **A2** | 1.1b |
| Time spent above 2 m is difference. | **M1** | 2.4 |
| 0.605… (s) (accept awrt 0.61) | **A1ft** | 3.4a |
| (8 marks) |
| Notes |

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| Q | Scheme | Marks | AOs | Pearson Progression Step and Progress descriptor |
| **4a** | Use of suvat equations | **M1** | 1.1a | 8thDerive formulae for projectile motion. |
|  | **A1** | 1.1b |
|  | **M1** | 1.1b |
|  | **A1** | 1.1b |
| Substitute *x* = 10 and *y* = −5 | **M1** | 1.1a |
| Solve *x* equation for *t* | **M1** | 1.1b |
|  | **A1** | 1.1b |
| Substitute into *y* equation | **M1** | 1.1a |
|  | **A1** | 2.1 |
| Use of | **M1** | 2.1 |
|  legitimately obtained | **A1** | 2.1 |
|  | **(11)** |  |  |
| **4b** | Solve for tan *θ* | **M1** | 1.1a | 8thSolve problems in unfamiliar contexts using the concepts of friction and motion. |
| tan *θ* = 0 or tan *θ* = 2 | **A1** | 1.1b |
| *θ* = 0 or 63.43…(°) (accept awrt 63) | **A1** | 1.1b |
|  | **(3)** |  |  |
| (14 marks) |
| **Notes** |