| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |   | M1 |
| A1 |
|  | DM1 |
|  | DM1 |
| A1 |
|  |  | **(5)** |
| **1(b)** |   | M1 |
|   | A1 |
|  | DM1 |
|  | DM1 |
| A1 |
|  |   | **(5)** |
|  |   | **(10 marks)** |
| **2(a)** | Integrate: ***v*** = **i** + **j** + **C** | M1 |
| A2 |
| : **v** = 9**i** + 12**j** + **C** = 11**i** + 10**j**  | DM1 |
|  **v** = **i** + **j** | A1 |
|  |  | **(5)** |
| **2(b)** | Parallel to **i**   | M1 |
|  ,  | A1 |
| (m s-1) | DM1 |
| A1 |
|  |  | **(4)** |
|  |  | **(9 marks)** |
| **3(a)** | Speed = (ms-1) | M1 A1 |
|  |  | **(2)** |
| **3(b)** | **a** = 2**i** - **j** | M1 A1 |
| When *t* = 4, **a** = 2**i** - **j** (ms-2) | A1 |
|  |  | **(3)** |
| **3(b)** | **r** = **i** –**j** + **C** | M1 A1 |
| t = 1, -4**i** + **j** = **i** - **j** + **C, C** = -5**i** + 2**j** | M1 |
| **r** = (- 5)**i** +**j** |  |
| When *t* = 4, **r** = (16-5)**i** + (-64 + 2)**j** = 11**i** - 62**j** | M1 A1 |
|  |  | **(5)** |
|  |  | **(10 marks)** |
| **4(a)** |  | M1 |
| A1 |
|  | M1 |
| A1 |
|  or  | M1 |
| A1 |
|  | DM1 |
| A1 |
|  | DM1 |
|  | A1 |
|  |  | **(10)** |
| **4(b)** |  | M1 |
| A1 ft |
|  | A1 |
|  |  | **(3)** |
|  |  | **(13 marks)** |
|  |  |  |
| **5(a)** | Considering energy:  | M1 |
| A2 |
|   | A1 |
|  |  | **(4)** |
| **5(b)** | Vertical distance:  | M1 |
|   | A2 |
|   | DM1 |
|   | A1 |
| Horizontal distance:  | M1 |
| A1 |
|  =14.0 (m) | A1 |
|  |  | **(8)** |
|  |  | **(12 marks)** |
| **6(a)** |  | M1 |
|  | A1 |
|  |  |
|    | B1 |
|  \* | M1 A1 |
|  |  | **(5)** |
| **6(b)** |  | M1 |
|  | A1 |
| OR use components from (a) and Pythagoras. |  |
|  |  | **(2)** |
| **6(c)** |   | M1 |
|  |  |
|  | M1 |
|  | A1 |
|  |  | **(3)** |
| **6(d)** |  or *v* = –8.8+*gT* | M1 |
| *v =* 13.96 | A1 |
| Horiz speed = 4 |  |
|  | M1 |
| A1 |
|  | A1 |
|  |  | **(5)** |
|  |  | **(15 marks)** |
| **7(a)** | Using  Method must be clear | M1 |
|  Answer given | A1 A1 |
|  |  | **(3)** |
| **7(b)** |  | M1 |
| quadratic formula: *t* =  | DM1 |
| *T* = 2.03(s), 2.0 (s) positive solution only. | A1 |
|  |  | **(3)** |
| **7(c)** | Differentiating the position vector (or working from first principles) | M1 |
| **v** = 3**i** + (5 – 9.8*t*)**j** (ms-1) | A1 |
|  |  | **(2)** |
| **7(d)** | At *B* the **j** component of the velocity is the negative of the **i** component: 5 | M1 |
| – 9.8*t* = -3, 8 = 9.8*t*,  | A1 |
|  |  | **(2)** |
| **7(e)** | *t* = 0.82  |  |
| **v** = 3**i** – 3**j**, speed = (m s-1) | M1A1 |
|  |  | **(2)** |
|  |  | **(12 marks)** |
| **8(a)** | **i** → distance = 6*t* | B1 |
| **j** ↑ distance =  | M1 A1 |
| At *B*,  | M1 A1 |
|   | M1 |
|  ,  | A1 |
|  |  | **(7)** |
| **8(b)** | **i** → speed = 6 | B1 |
| **j** ↑ velocity = 12 – *gt* = -6 | M1 A1 |
| speed at *A*  |  |
| =  | M1 A1 |
|  |  | **(5)** |
| **8(c)** | ↑ speed = 12 – *gt* = +6 | M1 A1 ft |
|   | A1 |
|  |  | **(3)** |
|  |  | **(15 marks)** |
| **9(a)** | After 4 seconds from *O*, horizontal speed  | B1 |
|  Vertical component of speed at *A* =  | M1 |
|  =  | A1 |
| At *A*, components are (horizontal) and (vertical) | B1 |
|   | dM1 |
|   () | A1 |
|   (47) | A1 |
|  |  | **(7)** |
| **9(b)** |  or   | M1 |
|  (s) or 1.0 (s) | A1 |
|  |  | **(2)** |
| **9(c)** | Total time = | B1ft |
| Range =  (or ) | M1 |
|  (m) or 127 (m) (130)  | A1 |
|  |  | **(3)** |
|  |  | **(12 marks)** |
| **10(a)** |  | M1 |
| A1 |
|  | M1 |
| A1 |
|  | DM1 |
|  | DM1 |
|  | A1 |
|  |  | **(7)** |
| **10(b)** |  |  |
|  | M1 |
|  | A1 A1 |
|  |  | **(3)** |
| **10(c)** |  | M1A1ft |
| **Answer given**\* | A1 |
|  |  | **(3)** |
| **10(d)** |  | M1A1 |
|  | A1 |
|  |  | **(3)** |
|  |  | **(15 marks)** |
| **11(a)** |  | M1 |
| A1 |
|  \* | A1 |
|  |  | **(3)** |
| **OR** | conservation of energy: | M1 |
|  | , | A1 |
|  \* | A1 |
|  |  | **(3)** |
| **11(b)** |  | M1 |
| A1 |
| A1 |
| 49*t*2 – 140*t* – 525 = 0 | DM1 |
|  (*t* – 5)(49*t* + 105) = 0 *t* = 5 | A1 |
| (→) 50 = 5 | M1 |
| = 10 | A1 |
|  | M1 |
|  m s–1  | A1 |
|  |  | **(9)** |
| **11(c)** | tan *OBA* =  | Correct direction o.e. (accept reciprocal) | B1 |
| = 1.05 × 10 = 10.5 | Use trig with their and correct interpretation of direction to find the vertical component of the speed | M1 |
| (↑) – 10.5 = 14 – *gt* | Use suvat to form an equation in *t*. Dependent on the preceding M. | DM1 |
| Correct equation for their  For incorrect direction give A0 here | A1 |
| *t* = 2.5 | only | A1 |
|  |  | **(5)** |
|  |  | **(17 marks)** |
| **12(a)** |  |  |
|  | B1 |
|  | M1 |
|  | DM1 |
|  **\*\*** | A1 |
|  |  | **(4)** |
| **12(b)** |  | M1 A1 |
|  |  |
|  | M1 |
|  |  |
|  | M1 |
|  | A1 |
|  |  | **(5)** |
| **12(c)** | Time to travel 8.922 m horizontally  | M1 |
|  | M1 A1 ft |
|  | A1 |
|  |  | **(4)** |
|  |  | **(13 marks)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | M2 2012 | 1 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 3.1a |
| 2 | M2 2014 | 2 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 3.1a |
| 3 | M2 Jan 2012 | 2 |   | Kinematics of a particle moving in a straight line or plane | 1.1a, 1.1b, 3.1a |
| 4 | M1 2013R | 5 |   | Kinematics of a particle moving in a straight line, Problems with friction | 1.1b, 1.2, 3.1, 2.2a, 3.1b, 3.2 |
| 5 | M2 2014 | 6 |   | Kinematics of a particle moving in a straight line or plane, Work and energy | 1.1b, 2.1, 3.1b |
| 6 | M2 Jan 2013 | 6 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2,1, 2,2a, 3.1b |
| 7 | M2 Jan 2011 | 6 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.1, 2.2a, 3.1b |
| 8 | M2 Jan 2012 | 7 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.2a, 3.1b |
| 9 | M2 2015 | 7 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.1, 3.1b |
| 10 | M2 2013R | 7 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.1, 2.2a, 3.1b |
| 11 | M2 2012 | 7 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.2a, 3.1b |
| 12 | M2 2011 | 8 |   | Kinematics of a particle moving in a straight line or plane | 1.1b, 2.1, 2.2a, 3.1b, 3.3, 3.4 |