| **Question** | **Scheme** | **Marks** |
| --- | --- | --- |
| **1(a)** |  | M1 |
| A1 |
|  | M1 |
| A1 |
|  | DM1 |
| A1 |
|  |  | **(6)** |
| **1(b)** |  | M1 |
| A1 |
|  | DM1 |
| A1 |
|  | B1 |
|  |  | **(5)** |
|  |  | **(11 marks)** |
| **2** | 4*u*0 *x**v*3*m* *m* |  |
|  | M1 A1 |
|   | M1 A1 |
|   |  |
|   |  |
|   | DM1 A1 |
|   | DM1 |
|  **\*\*** | A1 |
|  |  | **(8 marks)** |
| **3(a)** | Speed after impact =  | B1 |
| Impulse = change in momentum =  | M1 |
|  | A1 |
|  |  | **(3)** |
| **3(b)** | Speed after second collision =  | B1 |
| Total time taken =  | M1 |
| A2 |
| Ratio of times for the three sections is  | M1 |
| A2 |
| ,  o.e. | DM1 |
| A1 |
|  |  | **(6)** |
|  |  | **(9 marks)** |
| **4(a)** | PE lost  J | M1 |
| A1  |
|  |  | **(2)** |
| **4(b)** |  | M1 |
| A2 |
|  N | A1 |
|  | B1 |
|  | M1 |
| A1  |
|  |  | **(7)** |
| **4(c)** |  | M1 |
| A1 |
|  | DM1 |
|  | A1  |
|  |  | **(4)** |
|  |  | **(13 marks)** |
| **5(a)** | *u**u**u**v**w* |  |
| Momentum: *u* = *u*’ + *v* | M1 A1 |
| NEL: *v* - *u*’ = *eu* | M1 A1 |
| 2*v* = *u*(1 + ),  | M1 A1 |
|   | A1 |
|  |  | **(7)** |
| **5(b)** | KE lost =  their speeds | M1 |
|  =  | A2 – 1ee |
|  =  **AG** | A1 |
|  |  | **(4)** |
| **5(c)** | Speed of C =   | M1 A1M1 A1 |
|  |  | **(4)** |
|  |  | **(15 marks)** |
| **6(a)** | CLM:  | M1A1 |
| Impact: | M1A1 |
| Subst :  | DM1 |
|  |  **\*Answer Given\*** | A1 |
|  |  | **(6)** |
| **6(b)** |  | B1 |
| CLM:  and Impact:  | M1A1 |
| Subst:  | DM1 |
|  ,   | A1A1 |
|  |  | **(6)** |
| **6(c)** |  | B1 |
|  Speed of separation =  | M1A1 |
|  |  | **(3)** |
|  |  | **(15 marks)** |
| **7(a)** |  *u* 0 *A B* *m* 3*m* *v w* |  |
|  | M1 |
|  | A1 |
|  | M1 |
|  | A1 |
|  | M1 A1 |
|  | A1 |
|  |  | **(7)** |
| **7(b)** |  0 *B C* 3*m* 4*m* *Y X* |  |
|  | M1 |
|  | A1ft |
|  | B1ft |
|  | DM1 |
| Or  |  |
|  | A1 |
|  | A1 |
|  |  | **(6)** |
| **7(c)** |  | M1 |
|  |  |
| , 0.293 | M1 |
|  for so no second collision. | A1 |
|  |  | **(3)** |
|  |  | **(16 marks)** |
| **8(a)** |  |  |
|  | M1 A1 |
|  | M1 A1 |
|  , () | dM1 |
| For *Q* and *R* to collide require ,  | M1 |
| ,  | A1 |
|  |  | **(7)** |
| **8(b)** | ,  | B1 |
|  | M1 |
|  | A1 |
| ,  |  |
| Solve for *x* (or  )  | dM1 |
|  ,  | A1 |
| *P* and *Q* moving away from each other, so no collision. | A1 |
|  |  | **(6)** |
|  |  | **(13 marks)** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | M2 2012 | 2 | 3.1, 3.2 | Collisions | 1.1b, 2.2a, 2.5, 3.1b |
| 2 | M2 2011 | 2 | 3.1, 3.2 | Collisions | 1.1b, 1.2, 3.1b |
| 3 | M2 2014 | 5 | 3.1, 3.2 | Collisions | 1.1b, 2.1, 3.1b |
| 4 | M2 2013R | 5 | 3.1, 3.2 | Collisions | 1.1b, 2.1, 3.1b |
| 5 | M2 Jan 2012 | 6 | 3.1, 3.2 | Collisions | 1.1b, 1.2, 2.2a, 3.1b, 3.4 |
| 6 | M2 2013 | 7 | 3.1, 3.2 | Collisions | 1.1b, 2.1, 2.2a, 3.1b, 3.2a, 3.4 |
| 7 | M2 Jan 2013 | 7 | 3.1, 3.2 | Collisions | 1.1b, 1.2, 2.1, 2.2a, 2.5, 3.1b, 3.2a |
| 8 | M2 2015 | 8 | 3.1, 3.2 | Collisions | 1.1b, 2.1, 2.2a, 3.1b, 3.2a, 3.4 |