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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **1a** | States that *a* = −4. 6 – 2 + *a* = 0 may be seen. | **B1** | 1.1b | 4th  Understand Newton’s first law and the concept of equilibrium. |
| States that *b* = −5. −4 + 9 + *b* = 0 may be seen. | **B1** | 1.1b |
|  | **(2)** |  |  |
| **1b** | States that **R** = 2**i** – 9**j** (N). | **M1** | 1.1b | 4th  Calculate resultant forces using vectors. |
| States that the magnitude of | **M1** | 1.1b |
| States(N) or *R* = 9.21… (N). Accept awrt 9.2 (N). | **A1** | 1.1b |
|  | **(3)** |  |  |
| **1c** | States | **M1** | 1.1b | 4th  Calculate resultant forces using vectors. |
| Finds the value of *θ*: *θ* = 77.47…(°). Accept awrt *θ* = 77.5 (°). | **A1 ft** | 1.1b |
|  | **(2)** |  |  |
| **(7 marks)** | | | | |
| **Notes**  **1b**  Award second method mark and accuracy mark for a correct answer using their *R*.  **1c**  Award ft marks for correct answer using their **R** vector from part **a**. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **2a** | States *F* = *ma* or implies use of *F* = *ma*  For example, −120 = 80 × *a* is seen. | **M1** | 3.3 | 4th  Use Newton’s second law to model motion in one direction. |
| Correctly finds (m s−2) or *a* = −1.5 (m s−2). | **A1** | 1.1b |
| States *v* = *u* + *at*, or implies its use. For example,  is seen. | **M1** | 3.1b |
| Finds *t* = 12 (s). | **A1 ft** | 1.1b |
|  | **(4)** |  |  |
| **2b** | States that  or implies it use by writing | **M1** | 2.2a | 4th  Use Newton’s second law to model motion in one direction. |
| Correctly finds *s* = 108 (m). | **A1 ft** | 1.1b |
|  | **(2)** |  |  |
| **2c** | States that the cyclist is not a particle, or states that the resistive force is unlikely to be constant. | **B1** | 3.5 | 4th  Use Newton’s second law to model motion in one direction. |
|  | **(1)** |  |  |
| **(7 marks)** | | | | |
| **Notes**  **2a**  Award ft marks for a correct answer using their value for acceleration.  **2b**  Award ft marks for a correct answer using their value for acceleration. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **3a** | Either states that or | **M1** | 1.1b | 5th  Use Newton’s second law to model motion in two directions. |
| Correctly find | **M1** | 1.1b |
| Interprets *a* in the context of the question, stating | **A1** | 3.2 |
|  | **(3)** |  |  |
| **3b** | States that the magnitude of | **M1** | 1.1b | 5th  Use Newton’s second law to model motion in two directions. |
| States *R* = 20 (N). | **A1 ft** | 1.1b |
|  | **(2)** |  |  |
| **3c** | States *F* = *ma* or implies use of *F* = *ma*. For example 20 = 6 × *a* is seen. | **M1** | 3.3 | 5th  Use Newton’s second law to model motion in two directions. |
| Correctly findsm s−2. | **A1 ft** | 1.1b |
|  | **(2)** |  |  |
| **3d** | States thator implies it use by writing | **M1** | 3.1b | 5th  Use Newton’s second law to model motion in two directions. |
| Solves to find(s). Accept awrt 19.6 (s). | **A1 ft** | 1.1b |
|  | **(2)** |  |  |
| **(9 marks)** | | | | |
| **Notes**  **3b**  Award ft marks for a correct answer using their value from part **a** for the **i** component of the force.  **3c**  Award ft marks for a correct answer using their value from part **b** for the resultant force.  **3d**  Award ft marks for a correct answer using their value from part **c** for the acceleration. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **4a** | States, or implies in a subsequent step, that the resistances to motion will total 1600*k* (N). (Any variable is acceptable.) | **M1** | 3.1b | 4th  Solve problems of connected particles in one dimension. |
| Uses *F* = *ma* to write | **M1** | 3.3 |
| Solves the equation to find *k* = 1.6 | **A1** | 1.1b |
| Finds the resistance forces acting on the trailer:(N). | **A1** | 1.1b |
|  | **(4)** |  |  |
| **4b** | Demonstrates an understanding that the resultant force for the trailer is *T* – 640, or for the car is 3200 – 1920 – *T* | **M1** | 3.1b | 4th  Solve problems of connected particles in one dimension. |
| Either states using the trailer or states using the car. | **M1** | 3.3 |
| Correctly finds *T* = 800 (N). | **A1 ft** | 1.1b |
|  | **(3)** |  |  |
| **4c** | Uses *F* = *ma* to write −640 = 400*a* | **M1** | 3.3 | 4th  Solve problems of connected particles in one dimension. |
| Correctly solves to find *a* = −1.6 m s−2 | **A1 ft** | 1.1b |
| Uses  to write | **M1** | 3.1b |
| Correctly solves to find *s* = 195.31… (m). Accept awrt 195 (m). | **A1 ft** | 1.1b |
|  | **(4)** |  |  |
| **4d** | States ‘the acceleration of the car will be equal to the acceleration of the trailer’ or states ‘the car and the trailer will move as one’. | **B1** | 3.5 | 4th  Solve problems of connected particles in one dimension. |
|  | **(1)** |  |  |
| **(12 marks)** | | | | |
| **Notes**  **4b**  Award ft marks for a correct answer using their value from part **a** for the resistance acting on the trailer.  **4c**  Award ft marks for a correct answer using their value from part **a** for the resistance acting on the trailer and from part **b** for tension. | | | | |

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| **Q** | **Scheme** | **Marks** | **AOs** | **Pearson Progression Step and Progress descriptor** |
| **5a** | Correctly uses to write | **M1** | 3.1b | 5th  Solve problems of connected particles using pulleys. |
| Correctly finds *a* =(m s−2) or 2.8125 (m s−2). Accept awrt 2.8 (m s−2). | **A1** | 1.1b |
|  | **(2)** |  |  |
| **5b** | Demonstrates an understanding that the resultant force acting on sphere *B* is 1.2*g* – *T*. | **M1** | 3.1b | 5th  Solve problems of connected particles using pulleys. |
| Uses *F* = *ma* to write | **M1** | 3.3 |
| Correctly solves to find *T* =(N) or 8.385 (N). Accept 8.4 (N). | **A1 ft** | 1.1b |
|  | **(3)** |  |  |
| **5c** | Demonstrates an understanding that the resultant force acting on box *A* is *T* – *F*. | **M1** | 3.1b | 5th  Solve problems of connected particles using pulleys. |
| Uses *F* = *ma* to write | **M1** | 3.3 |
| Correctly solves to find *F* = (N) or 6.135 (N). Accept 6.1 (N). | **A1ft** | 1.1b |
|  | **(3)** |  |  |

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| **5d** | Uses *v* = *u* + *at* to write | **M1** | 3.1b | 5th  Solve problems of connected particles using pulleys. |
| Solves to find *v* = or 2.25 m s−1. | **A1 ft** | 1.1b |
| Uses *F* = *ma* to write –*F* = 0.8*a* or −= 0.8*a* | **M1** | 3.1b |
| Solves to find *a* =m s−2 or 7.66…( m s−2). | **A1 ft** | 1.1b |
| Uses  to write | **M1** | 2.2a |
| Solves to find *s* =(m) or 0.33… (m). Accept awrt 0.33 (m). | **A1 ft** | 1.1b |
| States that the total distance travelled will be 1.23 m (0.9 + 0.33). | **B1 ft** | 3.2 |
|  | **(7)** |  |  |
| **(15 marks)** | | | | |
| **Notes**  **5b**  Award ft marks for a correct answer using their value from part **a** for acceleration.  **5c**  Award ft marks for a correct answer using their values from part **a** for acceleration and part **b** for tension.  **5d**  Award ft marks for a correct answer using their values from parts **a**, **b** and **c**. | | | | |