**Name of the Student**:_____
**Max. Marks : 22 Marks** **Time : 22 Minutes**

Mark Schemes

**Q1.**

| Question Number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| | • Use of $v = s/t$ for the horizontal motion (1)<br>**Or** see $u_h = 25\ m\ s^{-1}$<br>• Use of $s = ut + ½\ at^2$ with $s = 0$ (1)<br>**Or** $v = u + at$ with $t = 1.0$ s<br>**Or** see $u_v = 9.81\ m\ s^{-1}$ (1)<br>• Combining of horizontal velocity and vertical velocity expressions (1)<br>**Or** see $\tan\theta = \left(\frac{9.81}{25}\right)$<br>• $\theta = 21°$ | Example of calculation<br>horizontal motion:<br>$u_h = \frac{50\ m}{2.0\ s} = 25\ m\ s^{-1}$<br>vertical motion:<br>$0 = (u_v)\ (2.0\ s) + ½(-9.81\ m\ s^{-2})(2.0\ s)^2$<br>$u_v = 9.81\ m\ s^{-1}$<br>$\tan\theta = \frac{u_v}{u_h} = \frac{9.81\ m\ s^{-1}}{25\ m\ s^{-1}}$<br>$\theta = 21.4°$ | 4 |

**Q2.**

| Question number | Acceptable answers | Additional guidance | Mark |
|---|---|---|---|
| | An explanation that makes reference to the following points:<br>• Comment on the data **(1)**<br>• Correct consequent conclusion **(1)** | 4.43 is an anomalous value<br>So the mean value is too low<br>Accept<br>data is concordant<br>so mean value is correct | 2 |

**Q3.**

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| Question Number | Acceptable Answer | Additional Guidance | Mark |
|---|---|---|---|
| * | This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully sustained reasoning.<br><br>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.<br><br>The table shows how the marks should be awarded for indicative content and structure and lines of reasoning.<br><br>**Indicative content:**<br>IC1 The rider experiences a resultant force acting towards the centre (of the circular path)<br>IC2 This (resultant) force is constant, as the rider has a constant (angular) velocity **Or** the weight $W$ is constant<br>IC3 At the bottom of the circle $P$ and $W$ act in opposite directions, so $P$ must be greater than $W$<br>IC4 At the top of the circle $P$ and $W$ act in the same direction, and so $P$ must be less (than at the bottom of the circle)<br>IC5 $P$ is the weight the rider appears to have<br>IC6 The rider would feel heavier at the bottom of the circle **Or** the rider would feel lighter at the top of the circle | Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning<br><br>Accept "the rider experiences a centripetal force" | 6 |

| Number of indicative marking points seen in answer | Number of marks awarded for indicative marking points |
|---|---|
| 6 | 4 |
| 5–4 | 3 |
| 3–2 | 2 |
| 1 | 1 |
| 0 | 0 |

| | Number of marks awarded for structure of answer and sustained line of reasoning |
|---|---|
| Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout | 2 |
| Answer is partially structured with some linkages and lines of reasoning | 1 |
| Answer has no linkages between points and is unstructured | 0 |

| IC points | IC mark | Max linkage mark | Max final mark |
|---|---|---|---|
| 6 | 4 | 2 | 6 |
| 5 | 3 | 2 | 5 |
| 4 | 3 | 1 | 4 |
| 3 | 2 | 1 | 3 |
| 2 | 2 | 0 | 2 |
| 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 |

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**Q4.**

| Question Number | Answer | Mark |
|---|---|---|
| * | (QWC – Work must be clear and organised in a logical manner using technical wording where appropriate) **Either**<br>Initial momentum is zero<br>Nucleus and alpha particle have equal momentum **(1)**<br>(accept $m_n u_n = m_\alpha u_\alpha$ or $p_n = p_\alpha$) alpha particle and **(1)**<br>nucleus move in opposite directions Mass of alpha **(1)**<br>particle < mass of nucleus (therefore $v_n < v_\alpha$) **(1)**<br><br>**Or**<br>The nucleus and alpha particle exert an equal but opposite force on **(1)**<br>each other. **(1)**<br>Mass of alpha particle < mass of nucleus **(1)**<br>Acceleration of nucleus < acceleration of alpha particle<br>Force/acceleration acts for same time so $\Delta v$ for nucleus is smaller for **(1)**<br>nucleus | **4** |
| | **Total for question** | **4** |

**Q5.**

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<table>
<tr><th>Question Number</th><th>Additional guidance</th><th colspan="2">Mark</th></tr>
<tr><td>*</td><td>This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.<br><br>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.<br><br>The following table shows how the marks should be awarded for indicative content.
<table>
<tr><th>Number of indicative marking points seen in answer</th><th>Number of marks awarded for indicative marking points</th></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5 - 4</td><td>3</td></tr>
<tr><td>3 - 2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>
Indicative content<br>
• Sphere A applies a force to sphere B (on impact)<br>
• According to Newtons third law Sphere B will apply an (equal and) opposite force to Sphere A<br>
• This force opposes the motion of Sphere A<br>
• Sphere A decelerates, according to N2<br>
• The (resultant) force on sphere B accelerates B<br>
• The forces/impulse acting (on the spheres) are equal so the change in speeds/momentum are the same for each sphere.</td><td>The following table shows how the marks should be awarded for structure and lines of reasoning
<table>
<tr><th></th><th>Number of marks awarded for structure of answer and sustained line of reasoning</th></tr>
<tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout</td><td>2</td></tr>
<tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr>
<tr><td>Answer has no linkages between points and is unstructured</td><td>0</td></tr>
</table></td><td>6</td></tr>
</table>

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