

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

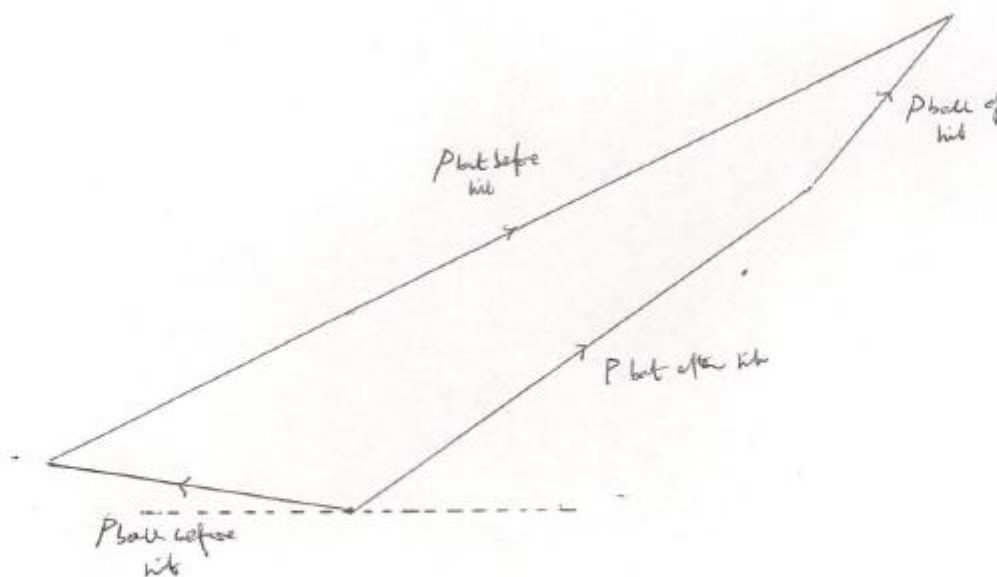
Mark Schemes

Q1.

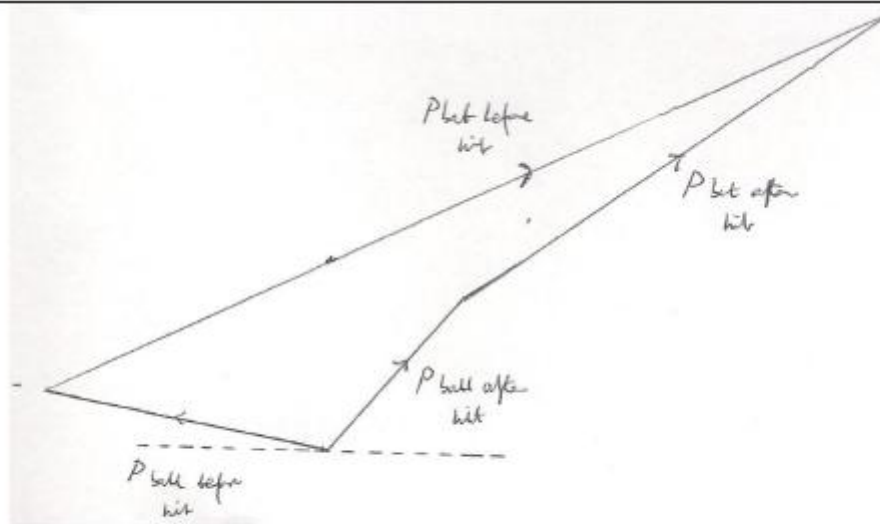
Question Number	Acceptable answers	Additional guidance	Mark
(i)	- Use of $V = Q/4\pi\epsilon_0 r$ - Identifies number of (positive) charges for alpha or gold nucleus - Use of $W = VQ$ $r = 5 \times 10^{-14} \text{ m}$ so textbook statement is correct Or $V = 7.27 \times 10^{-13} \text{ J}$ so textbook statement is correct (MP4 dependent on MP1)	(1) <u>Example of calculation</u> $7.30 \times 10^{-13} \text{ J} =$ (1) $\left(\frac{8.99 \times 10^9 \text{ Nm}^2 \text{C}^{-2} \times 79 \times 1.6 \times 10^{-19} \text{ C}}{r} \right) \times 2 \times 1.6 \times 10^{-19} \text{ C}$ (1) $r = 4.98 \times 10^{-14} \text{ m}$ (1)	4
(ii)	- Use of $E_k = \frac{p^2}{2m}$ - Converts atomic mass to kg $p = 9.9 \times 10^{-20} \text{ kg m s}^{-1}$	(1) Accept Use of $E_k = \frac{1}{2}mv^2$ and $p = mv$ (1) <u>Example of calculation</u> $7.30 \times 10^{-13} \text{ J} = p^2/2 \times 4 \times 1.66 \times 10^{-27} \text{ kg}$ (1) $p = 9.9 \times 10^{-20} \text{ kg m s}^{-1}$	3

Q2.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	$p = 3.33 \text{ (Ns)}$ (1)	<u>Example of calculation</u> $p = 0.140 \text{ kg} \times 23.8 \text{ m s}^{-1}$ $p = 3.33 \text{ kg m s}^{-1}$	1
(ii)	- Draws labelled vector line with a ruler representing $p_{\text{ball after}}$ (1) - at approximately the correct angle (50°) (1) - length of line scaled correctly Or recognises the scale is $1 \text{ cm} = 1 \text{ N s}$ (1) - either $p_{\text{ball after}}$ line or $p_{\text{bat after}}$ line should start at the start of the $p_{\text{ball before}}$ line. (1) - Momentum = $8.3 \text{ (Ns)} \pm 0.3$ and angle = $34^\circ \pm 3^\circ$ (1)	Accept a label such as "ball after" ie length of $p_{\text{ball after}}$ should be about 3(.3) cm This can only be given if there is a correct arrow and either label	5



Or



Q3.

Question Number	Acceptable answers	Additional guidance	Mark
(i)	- If the track is curved then a centripetal force is required - This force provided by reaction force between wheel and rails - The centripetal force is given by $F = mv^2/r$ - There will be a maximum speed at which the train will leave the track (and the train must travel at less than this speed) as there is a maximum value of reaction/friction (between wheels and rails)	Accept Force towards the centre Accept This force is provided by friction (between rail and wheels) Accept Train slips off track if centripetal force is larger than reaction/friction can provide	4
(ii)	- Use of constant $= v^2/r$ $r = 5800 \text{ m}$	<u>Example of calculation</u> As $v^2/r = \text{constant } (k)$ $k = 200^2 (\text{km h}^{-1})^2 / 1800 \text{ m} = 22.22$ $r = 360^2 (\text{km h}^{-1})^2 / 22.22 \text{ m} (\text{km h}^{-1})^2$ $r = 5840 \text{ m}$	2

Q4.

Question Number	Acceptable answers	Additional guidance	Mark
	• Use of $F = Gm_1m_2/r^2$ and $F = mv^2/r$ (1) • Use of $v = 2\pi r/T$ (1) • $T = 488\,000\text{ s} = 5.7\text{ days}$ (1) OR • Use of $F = Gm_1m_2/r^2$ and $F = m\omega^2r$ • Use of $\omega = 2\pi/T$ • $T = 488\,000\text{ s} = 5.7\text{ days}$	'Use of' can be with any mass m for the orbiting body, or by algebraic combination with no m <u>Example of calculation</u> $F = GMm/r^2 = mv^2/r$ $GM/r^2 = v^2/r$ $v = 2\pi r/T$ $T^2 = 4\pi^2 r^3 / GM$ $= 4\pi^2 (1.34 \times 10^8\text{ m})^3 / 6.67 \times 10^{-11}\text{ N m}^2\text{ kg}^{-1} \times 5.97 \times 10^{24}\text{ kg} = 2.39 \times 10^{11}\text{ s}^2$ $T = 488\,000\text{ s} = 5.7\text{ days}$	3