

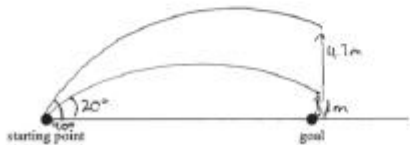
Name of the Student: _____

Max. Marks : 28 Marks

Time : 28 Minutes

Mark Schemes

Q1.

Question Number	Answer	Mark
(a)(i)	The ball has bounced Or the ball would be below initial height Or the ball has landed before reaching the goal Or the ball has hit the ground (1)	1
(a)(ii)	Correct shape of at least one trajectory, starting at the kick and ending at/beyond the goal (1) Range/position of the higher angle > range/position of lower angle ball seen with paths labelled (1) Example of response scoring 2 marks 	2

(b) (i)	Use of $(u_H) = u \cos 15$ Or $u \sin 75$ Or see $25(1) \text{ m s}^{-1}$	(1)	6
	Use of $u = s/t$ to calculate the time to the goal Or see 0.44 s	(1)	
	Use of $(u_V) = u \sin 15$ Or $u \cos 75$ Or see 6.7 m s^{-1}	(1)	
	Use of $s = ut + \frac{1}{2} at^2$ (a must be negative)	(1)	
	$s = 2.0 \text{ m}$	(1)	
	Use of (value obtained + the 0.22 m (or 0.11 m)) to make a sensible statement as to whether or not the goal will be scored e.g. the top of the ball on reaching the goal 2.23 m . (This is less than 2.4 m and) the goal will be scored	(1)	
	(Answer must be consistent with calculated distance. For calculated heights greater than 2.4 m , candidates do not need to refer to radius /diameter but a comparison of heights is needed.)		
	<u>Example of calculation</u> $t = \frac{11 \text{ m}}{26 \text{ ms}^{-1} \times \cos 15^\circ} = 0.44 \text{ s}$ $s = (26 \text{ m s}^{-1} \times \sin 15^\circ)(0.44 \text{ s}) + (\frac{1}{2})(-9.81 \text{ N kg}^{-1})(0.44 \text{ s})^2$ $s = 2.01 \text{ m}$ Height of the top of the ball on reaching the goal = $2.01 \text{ m} + 0.22 \text{ m} = 2.23 \text{ m}$		
(b) (ii)	Air resistance is in the opposite direction to the ball's motion Or air resistance adds a backwards force Or work is done against air resistance	(1)	2
	The ball will decelerate (horizontally) Or the ball will have a decreasing velocity/speed Or the ball will not travel as far Or this reduces the maximum height the ball reaches Or the ball is in the air for less time Or the ball will take longer to reach the goal	(1)	
Total for question			11

Q2.

Question Number	Acceptable Answers	Additional guidance	Mark
a	- fundamental – quarks and leptons (1) - Baryons made of 3 q (1) - Mesons made of quark and antiquark (1) 6 quark Or 6 leptons (1) - Each particle has an antiparticle (1)	MP2 and 3 could be given for a named particle and its quark composition Can be inferred if either set named	5

Question Number	Acceptable Answers	Additional guidance	Mark
b	- Use of $\Delta E = \Delta mc^2$ (1) - Conversion of J to eV (1) - mass = 120 GeV/c² (1)	Example of calculation: $E = 2.2 \times 10^{-25} \text{ kg} \times (3.0 \times 10^8)^2 (\text{ms}^{-1})^2$ $E = 1.98 \times 10^{-8} \text{ J}$ $E = 1.98 \times 10^{-8} \text{ J} \div 1.6 \times 10^{-19} \text{ J eV}^{-1}$ $E = 124 \times 10^9 \text{ eV}$	3

Question Number	Acceptable Answers	Additional guidance	Mark
c(i)	- Energy (of protons) converted to mass (of Higgs) (1) Or Energy is required to overcome electrostatic repulsion between protons - Reference to $E = mc^2$ (can be written in any form) (1) - Because c^2 is very large (E must be large) (1) Or Higgs particle is massive so needs a lot of energy to create it	Alternative based on numerical values: Observation that Higgs mass is 120 GeV/c ² This requires an energy of at least 120 GeV Each beam of protons would need an energy of at least 60 GeV	3
c(ii)	- Use of circumference = $2\pi r$ (1) - Use of $p = Bqr$ (1) $p = 5.7 \times 10^{-15} \text{ N s}$ (1)	Example of calculation: $r = 27000 \div 2\pi$ $r = 4300 \text{ m}$ $p = 8.3 \text{ T} \times 1.6 \times 10^{-19} \text{ C} \times 4300 \text{ m}$ $p = 5.7 \times 10^{-15} \text{ N s}$	3
ciii	0 (1)	zero	1

Question Number	Acceptable Answers	Additional guidance	Mark
d	- High speeds (1) Or relativistic - Mass (of proton) increases (1) - Or this equation is only valid at non-relativistic speeds	Alt: speeds close to speed of light	2