Marking Scheme

#1

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)		0.75 [±0.05] s		1		1	1	
	(ii)		68 m [±3 m]		1		1	1	
	(iii)		Figures correctly inserted into constant acc equation(s) at some chosen speed. For example, at 30 m s^{-1}, $0 = 30^2 + 2a \times 68$ [1] [Tolerate interchange of u and v and (for this mark only) stopping distance used instead of braking distance.] $a = -6.6$ m s^{-2} [±0.6 m s^{-2}; accept 6.6 m s^{-2}; **ecf** on 68 m] [1] Deceleration correctly calculated at one more speed **and** sensible conclusion drawn **ecf** [1] **Alternative:** For at least two points, $\frac{v_1}{v_2}$ compared with $\left(\frac{x_1}{x_2}\right)^2$ or equiv. [1] Comparison carried out with clear results [1] Sensible conclusion drawn, implying that square law relation is equivalent to same acceleration throughout [1]			3	3	2	
(b)			Quantitative use made of data in (a), e.g. from graph, stopping distance [on dry road at maximum legal speed] is ≈ 95 m. [1] Some conclusion, e.g. 95 m is rather greater than two gaps between chevrons [or equiv] so idea good or inadequate. [1] Critical/supporting remarks [1] could include: • Not enough distance if roads wet or icy, or no help in fog • Even longer distance needed if maximum legal speed exceeded **or** equiv • Should be ignored in a traffic jam • Meaning of notice not clear: 2 chevrons or 2 gaps apart? • Arguably use of chevrons too infrequent to save many accidents • Drivers could be distracted by looking at chevrons on road			3	3	2	
			Question total	**0**	**2**	**6**	**8**	**6**	**0**

#2

Question		Marking details	Marks available					
			AO1	AO2	AO3	Total	Maths	Prac
(a)	(i)	Rate of change of **displacement** / accept **displacement** ÷ time	1			1		
	(ii)	Circular motion with a constant speed / accept practical example (1) Object being thrown up in the air or object decelerating / accept practical example (1)		2		2		
(b)	(i)	Gradient calculated (1) g = [-]9.8 m s^{-2} with units (1) **Alternative;** Use of $v^2 = u^2 + 2ax$ or other suitable equation of motion (1) g = [-]9.8 m s^{-2} with units (1)		2		2	2	
	(ii)	An attempt at an area calculation (1) Height = 11.[025] [m] (1) **Alternative:** Use of equation of motion (1) Height = 11.[025] [m] (1)		2		2	2	
	(iii)	Zero		1		1		
(c)		Shape starts and ends at zero / graph is symmetric or parabolic (1) 11.025 m is the max height / gradient reduces to zero at max height (1) at a time of 1.5 s / time of flight is 3 s (1) Conclusion yes she is correct has to match with argument (1) Accept individual point checked as an alternative mark for either method			4	4	2	
		Question total	**1**	**7**	**4**	**12**	**6**	**0**

#3

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	*(a)*		Horizontal remains constant (1) vertical decreases to zero then increases / downward component increases (1)	2			2		
	(b)	(i)	$u_y = u\sin 20$ and $u_x = u\cos 20$ (1) $t = 0.035u$ or $t = \frac{21}{u\cos 20}$ (1) Horizontally $x = u\cos 20\, t$ (1) $v = 25.3$ [m s^{-1}] (1)		4		4	4	
		(ii)	Use of $v^2 = u^2 + 2ax$ (1) Use $v^2 = 0$ and manipulation (1) $x = 3.82$ [m] ball is above the bar (1)			3	3	3	
		(iii)	Ball wouldn't go as high / horizontal velocity decreases (1) [Vertical] velocity falls to $v = 0$ quicker / ball on the way down by the time it crosses the line (1)			2	2		
			Question 7 total	**2**	**4**	**5**	**11**	**7**	**0**

#4

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)	0.8%		1		1	1	1
		(ii)	0.51 must be to 2 s.f. no unit penalty (1) 2.9 / 3 % max of 2 s.f. (1)		2		2	2	2
		(iii)	Rearrangement to: $g = \frac{2h}{t^2}$ (1) $g = 9.61$ m s^{-2} 2 or 3 s.f. with units **ecf** from (a)(ii) 0.5133 gives 9.49 m s^{-2} (1) % uncertainty 6.6 / 6.8 % **ecf** on (i) + 2 × (ii) (1) ± 0.6[3] / 0.6[5] (1)		4		4	4	4
		(iv)	Lower due to air resistance. Accept ball not starting at rest			1	1		1
	(b)	(i)	Yes (no marks) easy to spot anomalous results (1) Mean obtained from line of best fit / larger height reduces [%] uncertainty (1)			2	2		2
		(ii)	h [on y-axis] vs t^2 [on x-axis] or $\sqrt{h}$ vs t (1) gradient = $\frac{g}{2}$ (1) **Alternative (1)** h on x-axis vs t^2 on y-axis (1) gradient = $\frac{2}{g}$ (1) **Alternative (2)** $2h$ on x-axis vs t^2 on y-axis (1) gradient = g (1)			2	2	1	2
			Question total	**0**	**7**	**5**	**12**	**8**	**12**

#5

Question			Marking details	AO1	AO2	AO3	Total	Maths	Prac
				Marks available					
	(a)		$\frac{\text{final velocity - initial velocity}}{\text{time [taken to change]}}$ or equivalent [1]	1			1		
	(b)	(i)	[Distance gone per second] = $2\pi \times 0.25$ [m] $\times$ 5.2×10^6 [s^{-1}] [1] = 8.2×10^6 [$m\,s^{-1}$] [1]	1	1		2	2	
		(ii)	acc = $\frac{(8.0\times10^6)^2}{0.25}$ [$m\,s^{-2}$] **or** $\frac{(8.17\times10^6)^2}{0.25}$ [$m\,s^{-2}$] [1] = 2.6 (or 2.7) $\times\ 10^{14}$ $m\,s^{-2}$ **unit mark** [1] South or towards circle centre. Accept downwards. [1]	1 1	1		3	1	
		(iii)	Time for half revolution = $\frac{1}{2} \times \frac{1}{5.2\times10^6}$ s [= 9.62×10^{-8} s] [1] Final velocity – initial velocity = 1.63×10^7 [$m\,s^{-1}$] [South] [1] Mean acc = 1.7×10^{14} [$m\,s^{-2}$] **South** [Accept South for Δv] [1]		3		3	2	
	(c)		Adam is wrong because acc's (or force) *direction* keeps changing [1] Brian is right because final vel – initial vel = 0 or equiv [1]			2	2		
			Question total	**4**	**5**	**2**	**11**	**5**	**0**

#6

Question			Marking details	AO1	AO2	AO3	Total	Maths	Prac
				Marks available					
1	*(a)*	(i)	Constant horizontal velocity if/because no horizontal force [1] That is if air resistance ignored or air resistance would/will make horizontal velocity decrease [1]	2			2		
		(ii)	From horiz motion, e.g. $t = \frac{6.0}{9.0}$ = 0.667 [s] [1] So from vertical motion, $y = \frac{1}{2}9.81\times\left(\frac{6.0}{9.0}\right)^2$ = 2.18 [m] ecf on t [1] Conclusion consistent [1] **Alternative:** From vertical motion, e.g. $t = \sqrt{\frac{2 \times 2.2}{9.81}}$ = 0.67[0] [s] ecf on t [1] From horiz motion, $v_h = \frac{6.0}{0.67}$ = 8.96 [$m\,s^{-1}$] ecf on t or $x = 9.0 \times 0.67$ = 6.03 [m] [1] Conclusion consistent [1] **Alternative**: Time from horiz motion = 0.67 [s] [1] Time from vertical motion = 0.67 [s] [1] Conclusion consistent [1]			3	3	2	
	(b)		Vertical velocity component, v_v = 6.5 [$m\,s^{-1}$] or 6.6 [$m\,s^{-1}$] [1] Diagram showing v_v, v_h and v_{res} or by implication if correct answer [1] Angle to horiz = 36° or angle to vertical = 54° [1] ecf on v_v Magnitude of velocity = 11 [$m\,s^{-1}$] [1] ecf on v_v		4		4	3	
			Question 1 total	2	4	3	9	5	0