

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(a)	(Starting and stopping stopwatch) (1) involves human reaction time (So) there will be (large) <u>random</u> (1) errors	Ignore references to human error	2
(b)(i)	The length of the metal cylinder (1)	Ignore length of the tube	1
(b)(ii)	Use of $v^2 = u^2 + 2as$ (1) $a = 9.62 \text{ m s}^{-2}$ (1)	Allow any valid suvat method to determine acceleration <u>Example calculation</u> $a = \frac{(2.96 \text{ m})^2 - (1.39 \text{ m})^2}{2 \times 0.355 \text{ m}} = 9.619 \text{ m s}^{-2}$	2
	Total for question		5

Q2.

Question Number	Answer	Mark
	• Reference to $s = ut + \frac{1}{2} at^2$ with $u = 0$ (1) • Correct variable labels on graph axes to give a straight line through origin. (1) • Reference to time in s and distance in m (this can be taken from the axes labels or a suitable unit conversion) (1) • Straight line through origin. (1) • Correct method to determine g using their graph. (1)	(5)

Q3.

Question Number	Answer	Mark
(a)	The ball fell a smaller distance (during each flash of the laboratory strobe) Or Each image of the ball would be smaller (using the laboratory strobe) (1) The uncertainty was less (with the laboratory strobe) MP2 dependent on MP1 (1)	2
(b)(i)	(allow a for g throughout) $s = (ut + \frac{1}{2}gt^2)$ and g is constant (1) Comparison of $s = \frac{1}{2}gt^2 (+ut)$ with $y = mx (+c)$ Or s is proportional to t^2 so the gradient of graph is constant (1)	2
(b)(ii)	Use of $s = \frac{1}{2}at^2$ and a pair of corresponding values from the graph Or Pair of corresponding values from the graph used to determine gradient (1) $g = 10.0 \text{ m s}^{-2}$ (allow answers in the range 9.8 m s^{-2} to 10.1 m s^{-2}) (dependent on MP1) (answer must be consistent with their calculation) (1) <u>Example of calculation</u> $\frac{\Delta h}{\Delta t^2} = \frac{0.30}{0.060} = 5.00$ $g = 5.00 \text{ m s}^{-2} \times 2 = 10.00 \text{ m s}^{-2}$	2
Total for question		6

Q4.

Question Number	Answer	Mark																					
(a)	- Length/height of wooden rod (1) - Distance from the rod to the light gate (1)	2																					
(b)	$v = \frac{\text{length of rod}}{\text{time (to pass through light gate)}}$ (1) - Repeat (at each height) and (calculate) an average (1)	2																					
(c)	- Repeat at different (release) heights (above the light gate and calculate v for each height) (1) - States an appropriate graph to draw (1) - Corresponding description of how to obtain the acceleration from the gradient (1) <table><tr><td>Graph</td><td>$s - v^2$</td><td>$v^2 - s$</td><td>$2s - v^2$</td><td>$v^2 - 2s$</td><td>$v^2/2 - s$</td><td>$s - v^2/2$</td></tr><tr><td>a</td><td>$1/(2 \times \text{gradient})$</td><td>$\text{gradient}/2$</td><td>$1/\text{gradient}$</td><td>$\text{gradient}$</td><td>$\text{gradient}$</td><td>$1/\text{gradient}$</td></tr><tr><td>Gradient</td><td>$1/2a$</td><td>$2a$</td><td>$1/a$</td><td>a</td><td>a</td><td>$1/a$</td></tr></table>	Graph	$s - v^2$	$v^2 - s$	$2s - v^2$	$v^2 - 2s$	$v^2/2 - s$	$s - v^2/2$	a	$1/(2 \times \text{gradient})$	$\text{gradient}/2$	$1/\text{gradient}$	gradient	gradient	$1/\text{gradient}$	Gradient	$1/2a$	$2a$	$1/a$	a	a	$1/a$	3
Graph	$s - v^2$	$v^2 - s$	$2s - v^2$	$v^2 - 2s$	$v^2/2 - s$	$s - v^2/2$																	
a	$1/(2 \times \text{gradient})$	$\text{gradient}/2$	$1/\text{gradient}$	gradient	gradient	$1/\text{gradient}$																	
Gradient	$1/2a$	$2a$	$1/a$	a	a	$1/a$																	
Total for question		7																					