
PHYSICS

9702/52

Paper 5 Planning, Analysis and Evaluation

March 2017

MARK SCHEME

Maximum Mark: 30

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the March 2017 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Answer	Marks
1	Defining the problem	
	<i>M</i> is the independent variable and <i>v</i> is the dependent variable, or vary <i>M</i> and measure <i>v</i>	1
	keep <i>x</i> /compression of spring <u>constant</u>	1
	Methods of data collection	
	labelled diagram including horizontal spring in line with vehicle attached to wall / retort stand	1
	use a ruler / calliper to determine compression of spring	1
	use of stopwatch / use of light gate connected to a timer / motion sensor correctly positioned	1
	use of balance to measure mass of vehicle <i>M</i>	1
	Method of Analysis	
	plots a graph of $1/v^2$ against <i>M</i> [Do not allow lg-lg graphs]	1
	<u>relationship valid</u> if a straight line produced	1
	$k = \frac{1}{\text{gradient} \times x^2}$ or $k = \frac{b}{y - \text{intercept} \times x^2}$	1

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Question	Answer	Marks
	Additional detail including safety considerations	Max 6
	D1 use safety screen; use goggles <u>to avoid ball / spring hitting eye</u>	
	D2 add masses to the vehicle to change M	
	D3 repeat experiment for each M and average v	
	D4 use of ruler to measure an appropriate distance for the time taken in stopwatch / light gate methods	
	D5 method to determine speed of vehicle, e.g. time vehicle over a measured distance <u>and</u> use speed = distance/time	
	D6 method to release ball with guide or support for spring / ball	
	D7 release the ball close to the vehicle	
	D8 detail on determining x e.g. difference between compressed length and original length	
	D9 method to ensure constant speed along track, e.g. friction compensate track / use of air track	
	D10 (relationship valid if a straight line produced) with (y -)intercept = $\frac{b}{kx^2}$	

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Question	Answer	Marks												
2(a)	gradient = Q/E y-intercept = $1/E$	1												
2(b)	<table border="1" data-bbox="360 320 1198 620"> <tbody> <tr> <td>4.0 or 4.00 or 4.000</td> <td>1.5 or 1.52</td> </tr> <tr> <td>3.0 or 3.03 or 3.030</td> <td>1.2 or 1.16</td> </tr> <tr> <td>2.1 or 2.13 or 2.128</td> <td>0.870 or 0.8696</td> </tr> <tr> <td>1.8 or 1.79 or 1.786</td> <td>0.769 or 0.7692</td> </tr> <tr> <td>1.5 or 1.47 or 1.471</td> <td>0.671 or 0.6711</td> </tr> <tr> <td>1.2 or 1.19 or 1.190</td> <td>0.610 or 0.6098</td> </tr> </tbody> </table> <p data-bbox="360 659 1630 691">First mark for all first column correct either 2 and 3 significant figures or 3 and 4 significant figures.</p> <p data-bbox="360 724 925 756">Second mark for all second column correct.</p>	4.0 or 4.00 or 4.000	1.5 or 1.52	3.0 or 3.03 or 3.030	1.2 or 1.16	2.1 or 2.13 or 2.128	0.870 or 0.8696	1.8 or 1.79 or 1.786	0.769 or 0.7692	1.5 or 1.47 or 1.471	0.671 or 0.6711	1.2 or 1.19 or 1.190	0.610 or 0.6098	2
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	absolute uncertainties from 0.4 to 0.1	1												
2(c)(i)	six points plotted correctly must be within half a small square	1												
	error bars in $1/P$ plotted correctly all error bars to be plotted	1												
2(c)(ii)	line of best fit drawn If points are plotted correctly then lower end of line should pass between (1.50, 0.70) and (1.65, 0.70) and upper end of line should pass between (3.60, 1.40) and (3.80, 1.40).	1												
	worst acceptable line drawn steepest or shallowest possible line mark scored only if all error bars are plotted	1												

Question	Answer	Marks
2(c)(iii)	gradient determined with a triangle that is at least half the length of the drawn line	1
	uncertainty = gradient of line of best fit – gradient of worst acceptable line or uncertainty = $\frac{1}{2}$ (steepest worst line gradient – shallowest worst line gradient)	1
2(c)(iv)	y-intercept determined by substitution into $y = mx + c$	1
	uncertainty = y-intercept of line of best fit – y-intercept of worst acceptable line or uncertainty = $\frac{1}{2}$ (steepest worst line y-intercept – shallowest worst line y-intercept).	1
2(d)(i)	E determined with correct unit using y-intercept $E = \frac{1}{y - \text{intercept}}$	1
	Q determined with correct unit using gradient and given to two or three significant figures penalise power of ten errors correct substitution of numbers must be seen $Q = E \times \text{gradient} = \frac{\text{gradient}}{y - \text{intercept}}$	1
2(d)(ii)	percentage uncertainty in Q correct substitution of numbers must be seen %uncertainty E + %uncertainty in gradient or %uncertainty in y-intercept + %uncertainty in gradient Maximum/minimum methods $\text{Max } Q = \text{max gradient} \times \text{max } E = \frac{\text{max gradient}}{\text{min } y - \text{intercept}}$ $\text{Min } Q = \text{min gradient} \times \text{min } E = \frac{\text{min gradient}}{\text{max } y - \text{intercept}}$	1