MARK SCHEME for the May/June 2015 series

9702 PHYSICS

9702/51

Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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 May/June 2015 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.

® IGCSE is the registered trademark of Cambridge International Examinations.



Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	51

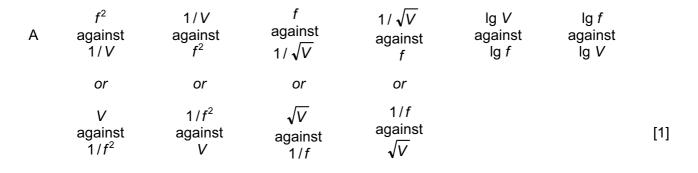
1 Planning (15 marks)

Defining the problem (3 marks)

Ρ	V is the independent variable, or vary V and f is the dependent variable, or measure f.	
	Or <i>f</i> is the independent variable, or vary <i>f</i> and <i>V</i> is the dependent variable, or measure <i>V</i> .	[1]
Ρ	Change <i>f</i> (allow <i>V</i>) until the mass leaves/gap between plate.	[1]
Ρ	Keep the position of the mass constant. (Do not allow keep mass constant.)	[1]
Ме	thods of data collection (5 marks)	
М	Labelled diagram showing <u>signal generator/a.c. supply</u> connected to vibrator with two wires with mass on plate. At least two labels needed.	[1]
М	Voltmeter/c.r.o. connected in parallel with vibrator in a workable circuit.	[1]
М	Measure <i>f</i> or <i>T</i> from signal generator/c.r.o. (Allow detailed use of motion sensor/stroboscope.)	[1]
М	Detail regarding mass leaving the plate: listen to noise, look for gap.	[1]
М	Repeat each experiment for the same value of <i>V</i> (allow <i>f</i> if consistent with above) and average.	[1]

Method of analysis (2 marks)

Plot a graph of:



А	$k =$ aradient × π^2	$k = \frac{\pi^2}{2}$	k =	$k = \frac{\pi^2}{\text{gradient}^2}$	$k = \pi^2 \times 10^c$	$k = \pi^2 \times 10^{2c}$	[1]
	gradient $\times \pi^2$	gradient	gradient $\times \pi^2$	gradient [∠]			

Safety considerations (1 mark)

S Precaution linked to mass leaving vibrating plate, e.g. use safety screen/goggles/sand tray.

[1]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	51

[4]

Additional detail (4 marks)

- D Relevant points might include
- 1 Wait for vibrator to oscillate evenly
- 2 Method to determine period of oscillation from c.r.o., i.e. one time period × time-base
- 3 Method to determine *f* from c.r.o. having determined *T*, i.e. f = 1/T
- 4 Method to determine V from c.r.o, i.e. amplitude (height) \times y-gain
- 5 Relationship is valid if the graph is a straight line passing through the origin [For Ig Ig graph the gradient must be correct (-2 or -0.5)]
- 6 Determine f (allow V if consistent with above) by increasing and decreasing V or f
- 7 Clean surfaces of metal plate/small mass
- 8 Spirit level to keep plate horizontal/eye level to look for gap

Do not allow vague computer methods.

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	51

2 Analysis, conclusions and evaluation (15 marks)

	Mark	Expected Answer		Additional Guidance		
(a)	A1	gradient = <i>m</i> <i>y</i> -intercept = lg <i>k</i>				
(b)	T1 T2	1.70 or 1.699	1.312 or 1.3118	Allow a mixture of significant figures. T1 (first column) and T2 (second column)		
		1.79 or 1.785	1.204 or 1.2041	must be values in table.		
		1.85 or 1.851	1.114 or 1.1139			
		1.90 or 1.903	1.041 or 1.0414			
		1.95 or 1.954	0.98 or 0.978			
		2.00 or 1.996	0.90 or 0.903			
	U1	From ±0.01 to ±0	0.03	Allow more than one significant figure.		
(c) (i)	G1	Six points plotter	d correctly	Must be within half a small square. Do not allow "blobs". Ecf allowed from table.		
	U2	Error bars in lg <i>P</i> plotted correctly		All error bars to be plotted. Must be accurate to less than half a small square.		
(ii)	G2	Line of best fit		Upper end of line must pass between (1.75, 1.24) and (1.75, 1.255) and lower end of line must pass between (2.00, 0.900) and (2.00, 0.915).		
	G3	Worst acceptable straight line. Steepest or shallowest possible line that passes through <u>all</u> the error bars.		Line should be clearly labelled or dashed. Examiner judgement on worst acceptable line. Lines must cross. Mark scored only if error bars are plotted.		
(iii)	C1	Gradient of line of best fit		be at least half Check the read		Must be negative. The triangle used should be at least half the length of the drawn line. Check the read-offs. Work to half a small square. Do not penalise POT. (Should be about –1.35.)
	U3	Uncertainty in gradient		Method of determining absolute uncertainty difference in worst gradient and gradient.		
(iv)	C2	<i>y</i> -intercept		Check substitution into <i>y</i> = <i>mx</i> + <i>c</i> . Allow ecf from (c)(iii) . (Should be about 4.) Do not allow read-off of false origin.		

Page 5		Mark Scheme			Paper
	C	ambridge International AS/A Level	9702	51	
	U4	Uses worst gradient an acceptable line. Do not check calculatio false origin used.			
(d) (i)	C3	$k = 10^{y-intercept}$			
	C4	m = gradient <u>and</u> given to 2 or 3 s.f. <u>and</u> in the range -1.30 to -1.44	Must be negative. Allow –1.3 or –1.4 (2 s.	f.)	
(ii)	U5	Percentage uncertainty in k			

Uncertainties in Question 2

(c) (iii) Gradient [U3]

uncertainty = gradient of line of best fit – gradient of worst acceptable line

uncertainty = 1/2 (steepest worst line gradient – shallowest worst line gradient)

(iv) [U4]

uncertainty = *y*-intercept of line of best fit – *y*-intercept of worst acceptable line

uncertainty = $\frac{1}{2}$ (steepest worst line *y*-intercept – shallowest worst line *y*-intercept)

(d) (ii) [U5]

max $k = 10^{\max y - \text{intercept}}$ and min $k = 10^{\min y - \text{intercept}}$

percentage uncertainty =
$$\frac{\max k - k}{k} \times 100 = \frac{k - \min k}{k} \times 100 = \frac{\frac{1}{2}(\max k - \min k)}{k} \times 100$$

.