

## Teacher Resource Bank

GCE Physics B: Physics in Context

Sample A2 ISA: Damped Harmonic Motion

- Mark Scheme



## AQA Physics Sample A2 ISA, Damped Harmonic Motion, Mark Scheme

Stage 1		Mark	Additional guidance notes
(a)	table with column headings showing all recorded results and correct units ✓	1	column headings can be either in words or standard symbols units can be in words or the correct abbreviation e.g. time/seconds, T/s alternative acceptable labelling includes time(s), time in s etc
(b)	significant figures correct for all readings ✓	1	distances quoted to nearest mm, e.g. 3.8 cm and timings compatible with precision of stopclock or stopwatch
(c)	at least two readings for the time of the oscillations and each scale reading ✓	1	e.g. records time for 10 oscillations (or 20 oscillations) etc and shows at least one repeat
(d)	correct computation of the amplitude and $t$ ✓	1	sample of calculations should be checked
(e)	correct computation of $\ln A$ ✓	1	no sf penalty on these values, sample of values checked
(f)	suitably large graph scale (do not award if scale on axis could have been doubled) ✓	1	the plotted points should occupy at least half of each axis
(g)	graph heading and correctly labelled axes with units ✓	1	alternative method of labelling axes as in (a) above table headings
(h)	most points accurately plotted to within 1 mm (no more than one point $> \pm 1$ mm) and line of best fit drawn ✓	1	this mark is independent of mark (g), i.e. if candidates have used an unsuitable scale they can still achieve marks for accurately plotting the points markers should check a proportion of plotted points 'most points' would typically allow one incorrect plot in a sample of 6 or 7 plotted points the line should be a straight line with approximately an equal number of points on either side of the line points which are obviously anomalous should not unduly influence the line if the plotted points suggest a curve line, the mark can be awarded for a suitable smooth curve
	<b>Total</b>	<b>8</b>	

Section A		Mark	Additional guidance notes
<b>Question 1</b>			
(a)	amplitude ✓	1	
(b)	mass and spring (or force) constant ✓	1	
(c)	reaction time may vary ✓ miscounting oscillations ✓	2	do not accept 'human error'
(d)	realistic estimate from spread of repeat times ✓	1	
(e)	% uncertainty = $\frac{\text{uncertainty}}{\text{largest time}} \times 100$ ✓	1	
(f)	(i) take logs ✓ $\ln A = \ln A_0 - \lambda t$ ✓ (ii) $-\lambda$ ✓ (iii) correct comment on validity of a straight line graph for their plotted points eg points lie close to a straight line ✓	4	
(g)	for example: use a position sensor ✓	1	accept other sensible suggestions
	<b>Total</b>	<b>11</b>	

Section B		Mark	Additional guidance notes
<b>Question 2</b>			
(a)	all 5 correct average $t_{1/2}$ values: 4.4, 12.2, 22.6, 34.7, 42.2 ✓  all 5 correct $\lambda^{-1}$ values: 6.21, 17.5, 32.6, 50.0, 61.0 ✓  correct significant figures ✓	<b>3</b>	must not be to more significant figures
(b)	correct scales and axes ✓ all plotted points to nearest mm ✓ best line of fit to points ✓	<b>3</b>	the line should be a straight line with approximately an equal number of points on either side of the line
(c)	large triangle drawn (at least 8 cm × 8 cm) ✓ correct values read from graph ✓ correct answer for gradient = 0.69 ✓ (allow 0.68 to 0.70 or calculation based on ecf from incorrectly read scale value(s))	<b>3</b>	
(d)	difference or % difference quoted ✓ discusses scatter of points ✓	<b>2</b>	
	<b>Total</b>	<b>11</b>	

Question 3		Mark	Additional guidance notes
(a)	0.2 s (half the spread) ✓	1	
(b)	random ✓	1	
(c)	closeness of repeat readings ✓	1	
(d)	(i) uncertainty in $\lambda^{-1}$ is also 0.2% ✓ (ii) uncertainty = $\frac{0.20}{42.2} \times 100 = 0.47\%$ ✓ (iii) $0.2 + 0.47 = 0.67\%$ ✓	3	no sf penalty
(e)	$t_{1/2}$ is inversely proportional to $\lambda$ ✓	1	
	<b>Total</b>	<b>7</b>	

Question 4		Mark	Additional guidance notes
	keeping card horizontal ✓ ensuring oscillations are vertical ✓ arranging the metre rule close enough ✓ card colliding with metre ruler ✓ $t_{1/2}$ not occurring at the end of an oscillation ✓ card wobbles ✓	max 4	
	<b>Total</b>	<b>4</b>	