Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
PSA	
Stage 1	
Section A	
Section B	
TOTAL (max 50)	

General Certificate of Education
Advanced Level Examination
June 2013

Physics (Specification A & B) PHY6T/Q13/test

Unit 6T A2 Investigative Skills Assignment (ISA) Q

For submission by 15 May 2013

For this paper you must have:	**Time allowed**
• your documentation from Stage 1 • a ruler with millimetre measurement • a calculator.	• 1 hour
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked. • Show all your working.	• The marks for questions are shown in brackets. • The maximum mark for this paper and Stage 1 is 41.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date.....

Section A

Answer **all** questions in the spaces provided.
You should refer to your documentation from Stage 1 as necessary.

1 (a) State the **independent variable** in your experiment.

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(1 mark)

1 (b) Describe **one** difficulty you encountered in measuring the amplitude.

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(1 mark)

1 (c) Suggest **two** ways of reducing random error in the measurement of time period *T*.

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(2 marks)

1 (d) Estimate the percentage uncertainty in your value for *T*.

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(1 mark)

1 (e) Theory predicts that the amplitude of the oscillations should vary with elapsed time, t, according to the equation, $A = A_o e^{-\lambda t}$ where A_o is the amplitude when $t = 0$ and λ is a constant.

1 (e) (i) Show that the equation can be represented in the form $\ln A = a + bt$, and hence identify the constants, a and b.

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(2 marks)

1 (e) (ii) State what the gradient of your Stage 1 graph represents.

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(1 mark)

1 (e) (iii) State what the y-intercept of your graph represents.

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(1 mark)

1 (e) (iv) Discuss how well your results fit the predicted theory.

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(3 marks)

Turn over ▶

1 (f) Discuss the possible effects on the accuracy of your measurements if a longer pendulum is used.

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(3 marks)

15

Section B

Answer **all** questions in the spaces provided.

2 A student performs an experiment similar to the one you did in stage 1 and finds the value of λ for different balls. The student also finds the time, $t_{1/2}$, for the amplitude to halve in each case. The results are recorded in the table below.

$t_{1/2}$/s				$\log_{10}(t_{1/2}/\text{s})$	λ/s^{-1}	$\log_{10}(\lambda/\text{s}^{-1})$
1st value	**2nd value**	**3rd value**	**Mean**			
3.9	4.1	4.0	4.0	0.602	1.79×10^{-1}	−0.747
11.0	11.1	10.9	11.0	1.041	6.34×10^{-2}	−1.198
20.3	20.5	20.1	20.3	1.307	3.41×10^{-2}	−1.467
31.4	31.2	31.1			2.22×10^{-2}	
38.2	37.8	38.0			1.82×10^{-2}	

2 (a) Complete the table.

(1 mark)

2 (b) Plot the two remaining points on the graph on page 6 and draw a straight line of best fit.

(2 marks)

2 (c) Determine the gradient of the graph.

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(3 marks)

2 (d) Theory predicts the gradient should be an integer. State the likely value of this integer and hence suggest the relationship between λ and $t_{1/2}$.

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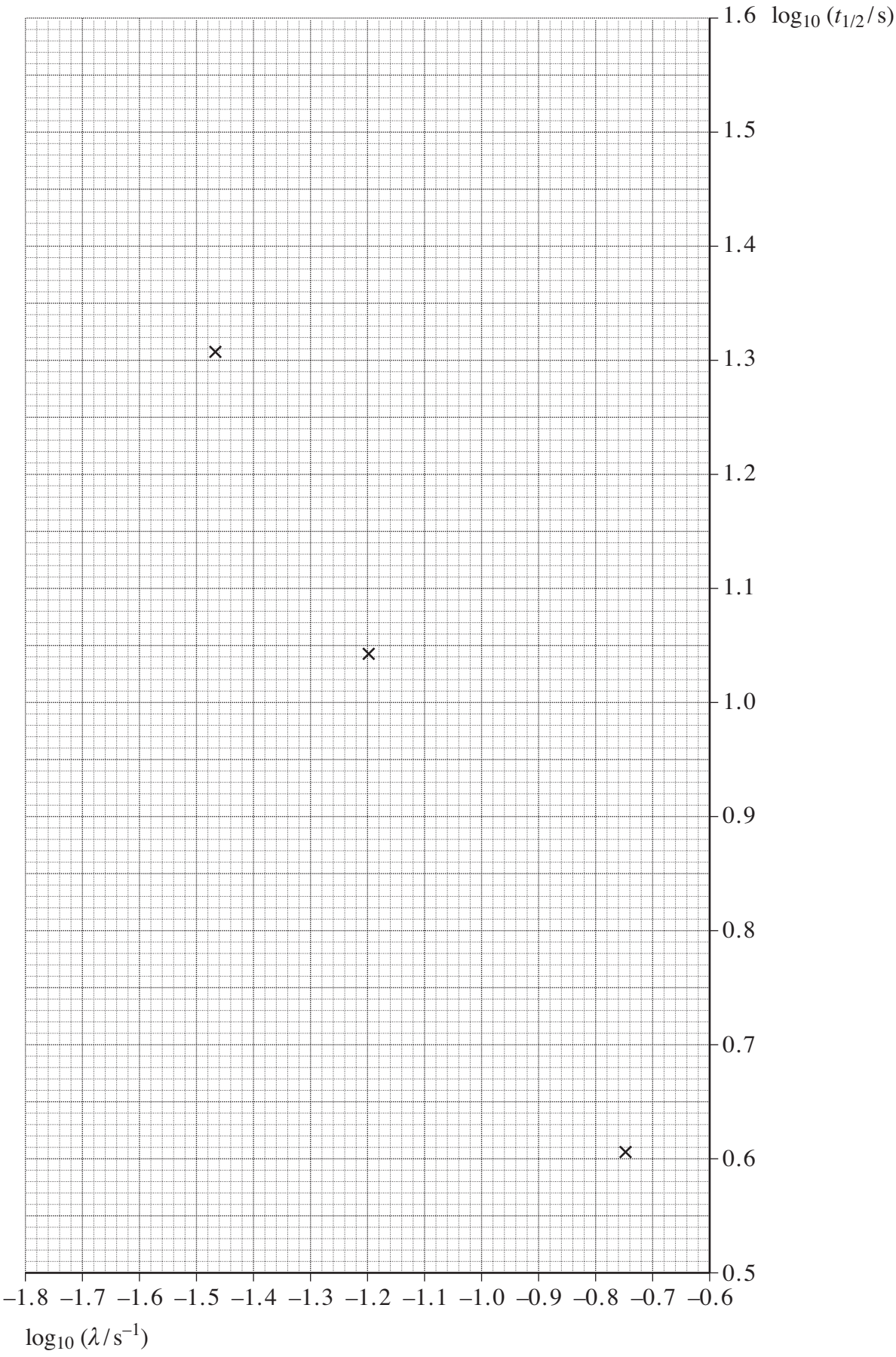
(2 marks)

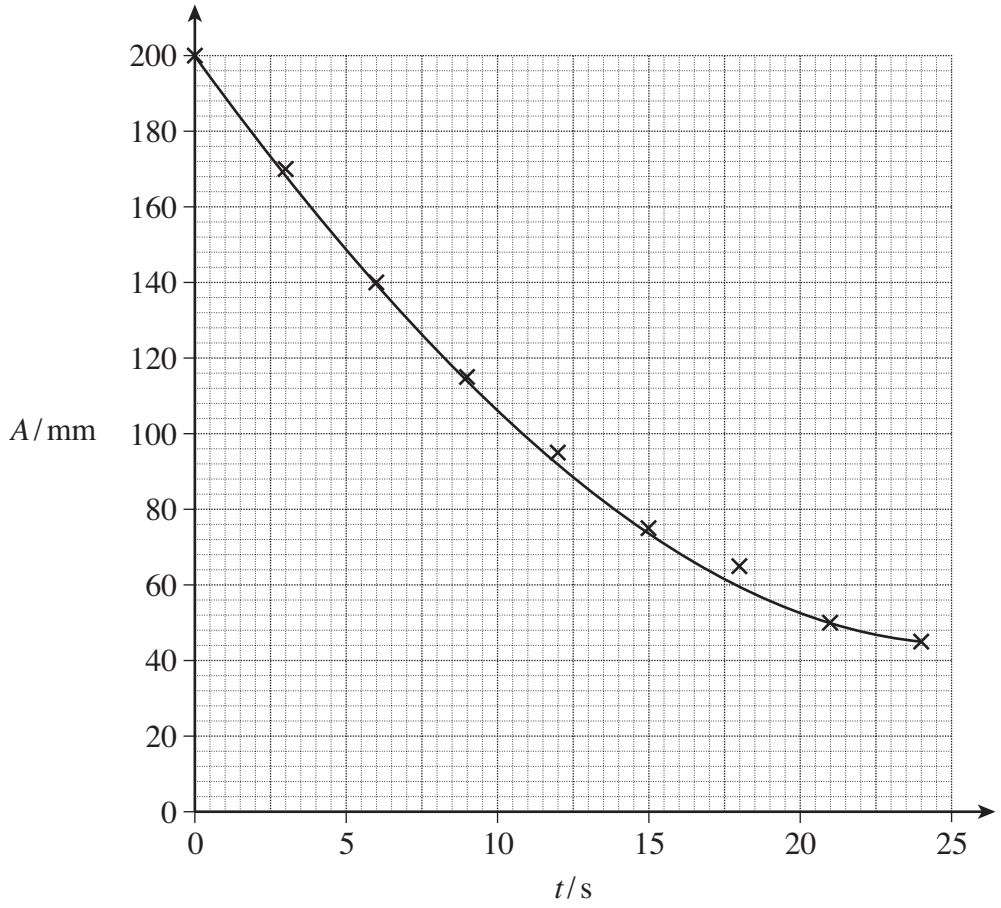
8

$\log_{10}(t_{1/2}/\text{s})$ against $\log_{10}(\lambda/\text{s}^{-1})$



3 To measure $t_{1/2}$ a student plotted a graph of A against t for each ball. One such graph is shown in **Figure 1**. Use this graph to determine $t_{1/2}$ for this ball.

Figure 1



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(3 marks)

3

Turn over ▶

4 (a) Calculate the percentage uncertainty in the largest mean value of $t_{1/2}$ from the table on page 5.

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(2 marks)

4 (b) The student estimates that the percentage uncertainty in the corresponding value of λ is ± 0.2%.

Calculate the percentage uncertainty in $\lambda t_{1/2}$ for the largest mean value of $t_{1/2}$.

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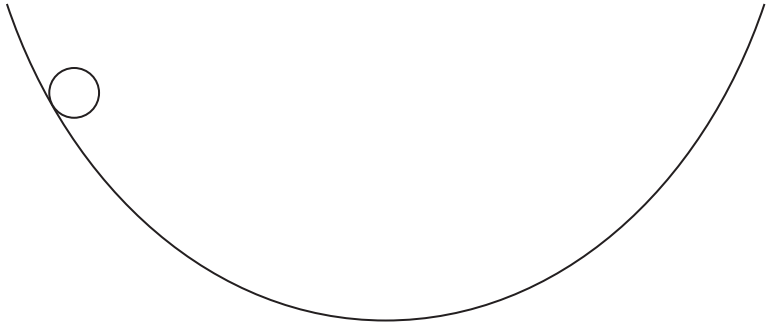
(1 mark)

3

5 **Figure 2** shows a steel ball on a spherically curved track. When released from the top of the track the ball oscillates with a decreasing amplitude.
Explain how you would investigate if the amplitude of the oscillation decreases exponentially with time.

Figure 2



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(5 marks)

END OF QUESTIONS

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