Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Teacher's Use		
		Mark
Stage 1		
Section A	**1**	
Section B	**2**	
	3	
	4	
TOTAL		

General Certificate of Education
Advanced Level Examination
June 2010

Physics PHY6T/P10/test

Unit 6 Investigative and Practical Skills in A2 Physics

Investigative Skills Assignment (ISA) P

Written Test

For this paper you must have:
- a calculator
- a ruler
- a protractor
- your completed documentation from Stage 1.

Time allowed
- 1 hour

Instructions
- 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 spaces provided. Attach your documentation from Stage 1 to this booklet before handing it to the invigilator at the end of the examination.
- Show all your working.
- Do all rough work in this booklet. Cross through any work you do not want to be marked.

Information
- The marks for the questions are shown in brackets.
- The maximum mark for this paper and the practical task is 41.

Signature of Teacher marking the ISA ..... Date .....

Section A

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

1 (a) What is the dependent variable in your experiment?

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(1 mark)

1 (b) State and explain the best position to place the reference marker (or fiducial marker) for timing the oscillations.

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(2 marks)

1 (c) State and explain **one** procedure, other than using the fiducial marker, that you used to reduce the uncertainty in the measurement of the time period of the oscillations.

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(2 marks)

1 (d) The effective length, L, of a V-shaped pendulum, is given by:

$$L^2 = s^2 - (d/2)^2$$

Theory shows that the time period, T, of the pendulum is given by:

$$T^2 = 4\,\pi^2 \frac{L}{g}$$

where g is the gravitational field strength.

1 (d) (i) Show that $T^4 = \dfrac{16\pi^4\, s^2}{g^2} - \dfrac{4\pi^4\, d^2}{g^2}$

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1 (d) (ii) By comparing the above equation with the general equation of a straight line, $y = mx + c$, state what should be plotted to obtain a straight line graph.

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1 (d) (iii) How could a value for g be obtained from this graph?

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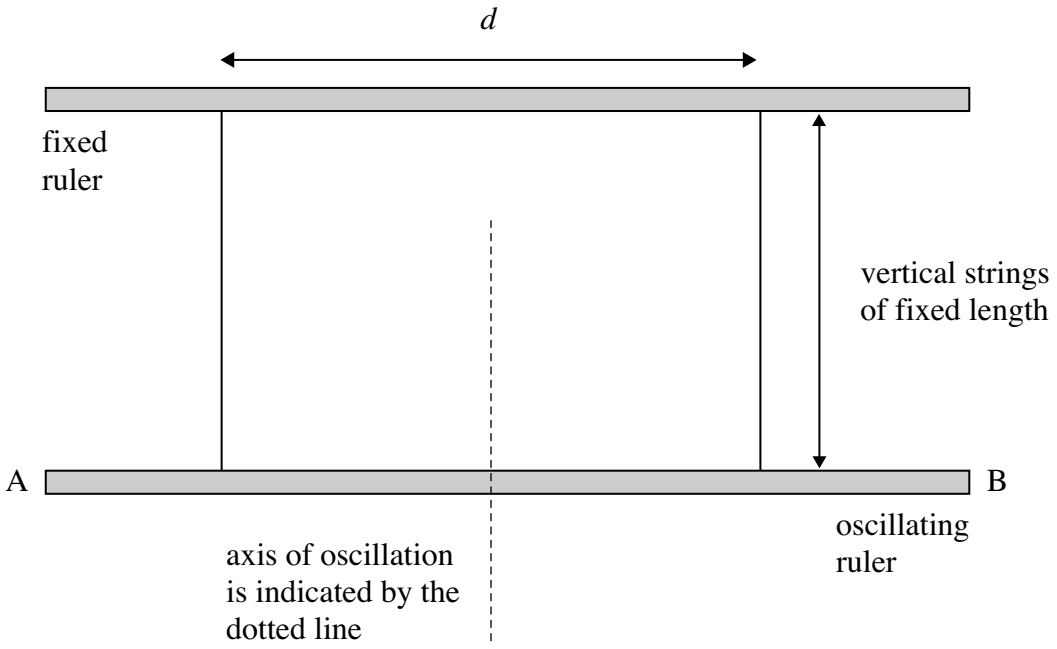
(3 marks)

8

Section B

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

2 The arrangement shown below consists of a metre ruler AB suspended horizontally from a second metre ruler clamped horizontally above it. When the ends of the bottom ruler are displaced in opposite directions, in a horizontal plane, the bottom ruler oscillates with simple harmonic motion.



A student conducts an experiment to investigate the relationship between the time period, T, of the suspended oscillating ruler, and the distance, d.
The student's results are shown in the table.

d/m	time for 20 oscillations / s			mean time period T/s	$\log_{10}(T/\text{s})$	$\log_{10}(d/\text{m})$
	reading 1	reading 2	reading 3			
0.800	20.20	20.38	20.02	1.01	0.0043	−0.097
0.700	23.52	23.16	23.28	1.17	0.0681	−0.155
0.600	27.26	25.92	27.30	1.34	0.127	−0.222
0.500	32.44	32.23	32.65	1.62	0.210	−0.301
0.400	41.41	41.15	41.33	2.07	0.316	−0.398
0.300	54.02	53.89	53.82			
0.200	80.82	80.91	80.67			

2 (a) (i) Inspection of the table shows an anomalous result in the timings for $d = 0.600$ m. State the most likely reason for the occurrence of this anomalous timing result.

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2 (a) (ii) The student decides to ignore all the data for $d = 0.600$ m, and not include it on the final graph. What would have been a better strategy in this situation?

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2 (a) (iii) Use data in the table for $d = 0.600$ m to calculate a more realistic value for the mean time period than the value given in the table.

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(3 marks)

2 (b) Complete the table by entering values for the mean time period, T, $\log_{10}(T/\text{s})$ and $\log_{10}(d/\text{m})$ for the values of $d = 0.200$ m and 0.300 m.

(2 marks)

2 (c) Complete the graph provided by plotting the remaining two points. Draw an appropriate straight line through the plotted points.

(2 marks)

2 (d) Determine the gradient G of your line.

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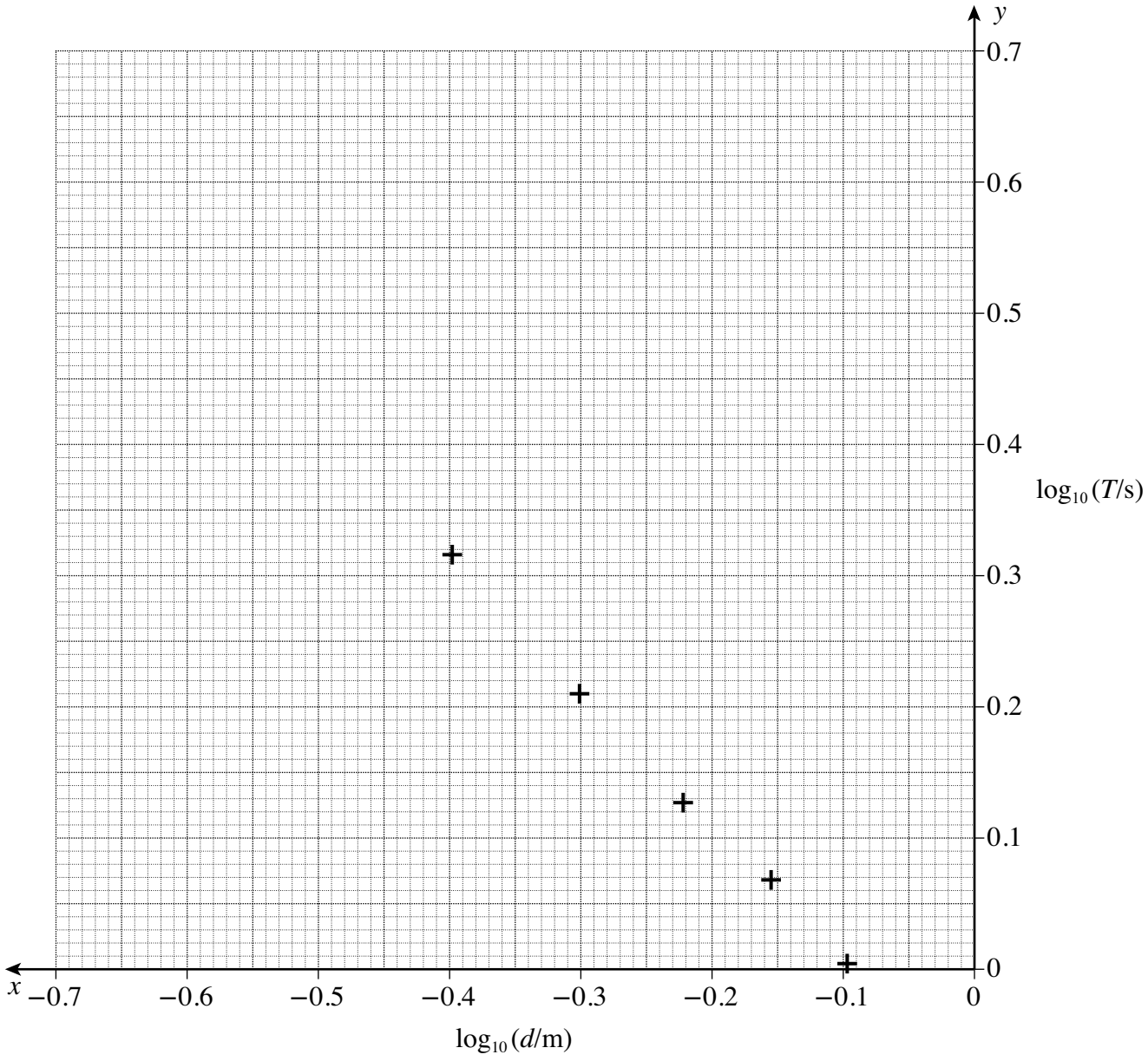
G _____

(3 marks)

Graph of $\log_{10}$ (T/s) against $\log_{10}$ (d/m)



2 (e) Theory shows that T and d are related by the equation

$$T = \frac{k}{d}$$

where k is a constant.

Discuss whether the value of G supports this theory.

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(2 marks)

12

Turn over for the next question

3 (a) Using the formula $T = \frac{k}{d}$, calculate a value for k for the shortest time period, T, and the corresponding distance, d. Give an appropriate unit for k.

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(2 marks)

3 (b) (i) For the result corresponding to the shortest time period, determine the percentage uncertainty in the value of time period T.

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3 (b) (ii) Assuming that distance, d, was measured with a metre ruler to the nearest mm, determine the percentage uncertainty in the corresponding value of d.

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3 (b) (iii) Hence calculate the overall percentage uncertainty in the value of k for these readings and convert this into a ± value, for the uncertainty in k.

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(5 marks)

7

4 A student investigates the feasibility of using an electronic timing device to time the oscillations. A small pin attached to the oscillating system passes through a light gate, placed at the centre of the oscillation. The device is set up so that when the pin first passes through the light gate it starts the electronic timer. When the pin passes through the light gate the next time, the timer stops.
In a trial timing, the electronic timer records a value of 0.51 s.

4 (a) What is the time period of the oscillation?

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(1 mark)

4 (b) Compare the accuracy of this method with a hand operated stopclock method used to obtain the timings in the table in Question 2.
The electronic timer has a precision of ± 0.01 s.

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(3 marks)

4 (c) State and explain **one** improvement you could make to the electronic method to increase the accuracy of the time period.

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(2 marks)

END OF QUESTIONS

6

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