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 Subsidiary Examination
June 2013

Physics (Specification A & B) PHY3T/P13/test

Unit 3T AS Investigative Skills Assignment (ISA) P

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) Theory predicts that the equation for the straight line you drew in Stage 1 is

$$L = A\left(\frac{M}{\cos\left(\frac{\theta_m}{2}\right)}\right) + B$$

where A and B are positive constants.

1 (a) (i) With reference to your graph, discuss whether your results support the theory.

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(2 marks)

1 (a) (ii) With reference to your graph, comment on the reliability of your data.

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(1 mark)

1 (a) (iii) Use your graph to find a value for B.

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(2 marks)

1 (a) (iv) Identify the physical quantity represented by B.

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(1 mark)

1 (b) (i) Use data from the table to estimate the uncertainty in L for $M = 100\,\text{g}$.

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(1 mark)

1 (b) (ii) Use data from the table to estimate the uncertainty in θ_m for $M = 100\,\text{g}$.

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(1 mark)

1 (b) (iii) For $M = 100\,\text{g}$, state which of the measured quantities in parts (b)(i) and (b)(ii) has the greater percentage uncertainty. Show your working.

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(1 mark)

1 (b) (iv) Without further calculation, state and explain whether your answer to part (b)(iii) would be the same for $M = 700\,\text{g}$.

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(3 marks)

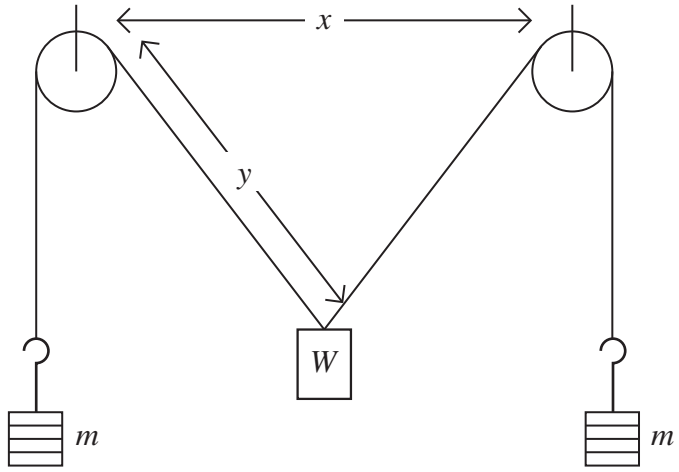
12

Section B

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

2 In an experiment similar to the one you performed in Stage 1 an unknown load, of weight, W, was supported by two strings kept in tension by equal masses, m, hung from their free ends, with each string passing over a frictionless pulley. The arrangement was symmetrical and is shown in **Figure 1**.

Figure 1



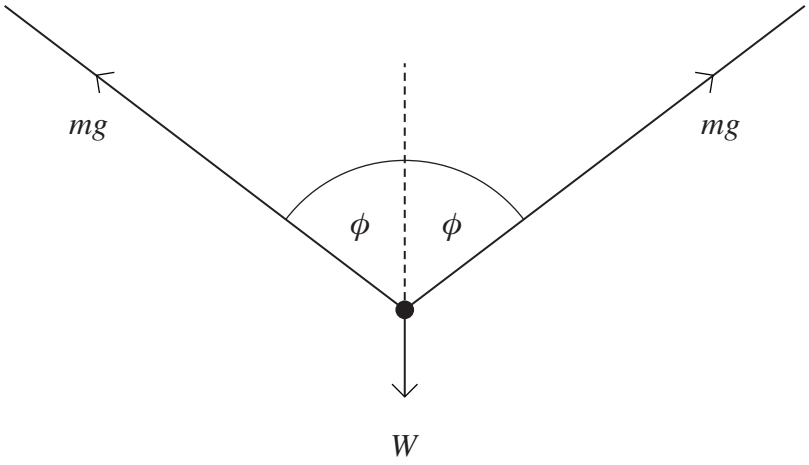
The distance x was kept constant throughout the experiment. The length y was measured for different values of m. The results are shown in the table.

The distance between the strings at the pulleys, $x = 0.500$ m

m / kg	y / m	$(\frac{x}{y})^2$	$\frac{1}{\sqrt{4-(\frac{x}{y})^2}}$
0.250	0.736	0.462	0.532
0.275	0.484	1.067	0.584
0.300	0.400	1.563	0.641
0.325	0.360	1.929	0.695
0.350	0.339	2.175	0.740
0.375	0.322		
0.400	0.308		

2 (a) **Figure 2** shows the three forces acting through the point at which the strings are attached to the load. The weight of the load is W and the tension in each string is mg, where g is gravitational field strength.

Figure 2



2 (a) (i) By resolving the forces vertically show that $m = \dfrac{W}{2g\cos\phi}$

where ϕ is the angle between each string and the vertical.

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(1 mark)

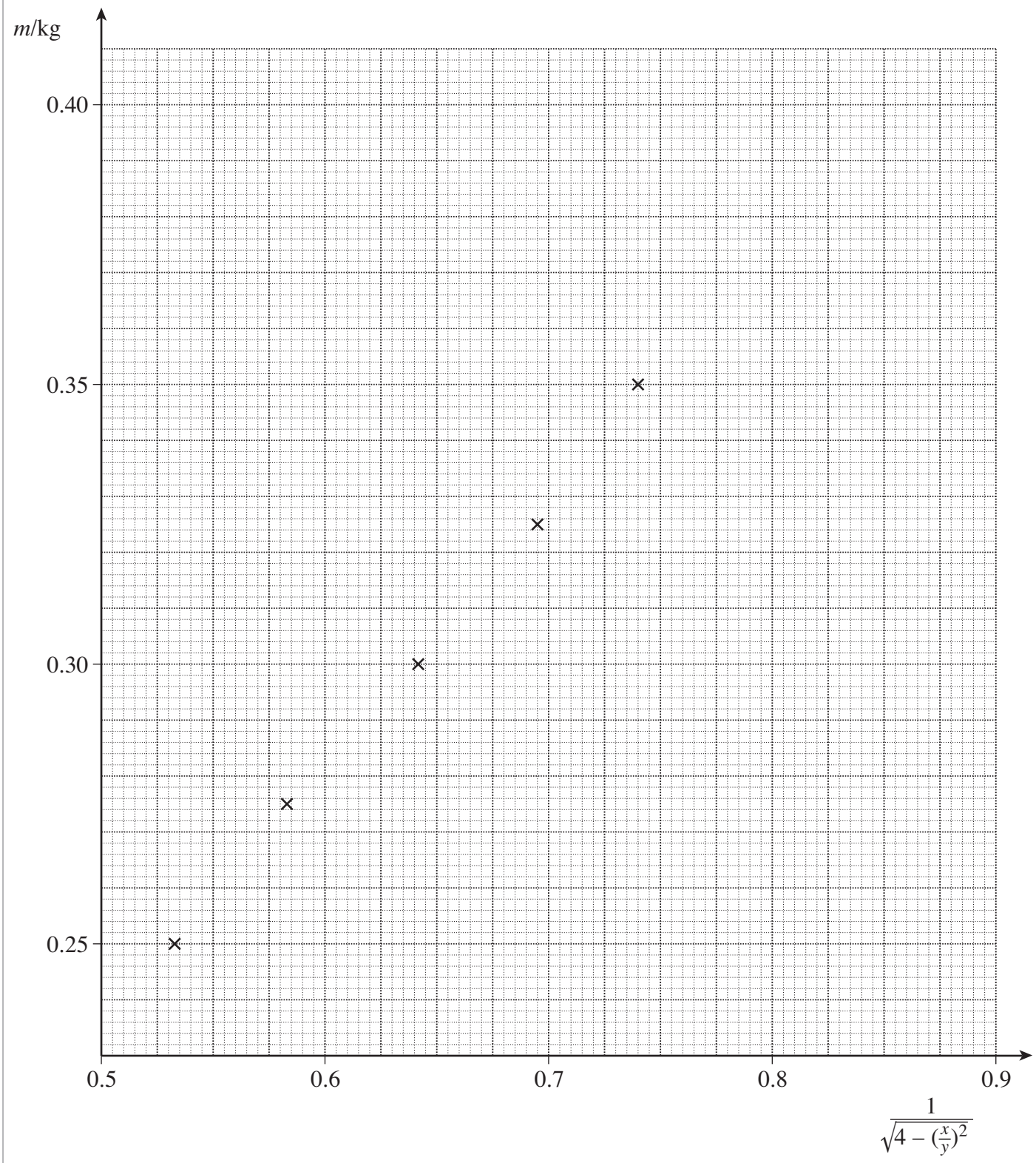
2 (a) (ii) Complete the table on page 4.

(2 marks)

2 (a) (iii) Complete the graph on the following page by plotting the missing two points and drawing a straight line of best fit.

(2 marks)

Turn over ▶



2 (b) (i) Determine the gradient of your graph.

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(3 marks)

2 (b) (ii) The equation for the straight line is $m = \frac{W}{g} \times \frac{1}{\sqrt{4 - (\frac{x}{y})^2}}$

Given that $g = 9.81\,\text{N kg}^{-1}$, determine a value for W.

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(2 marks)

2 (c) The uncertainty in the measurement of x was ± 1 mm and the uncertainty in the measurement of y was ± 2 mm. Calculate the percentage uncertainty in $(\frac{x}{y})^2$ for $m = 0.300\,\text{kg}$.

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(3 marks)

Turn over ▶

2 (d) (i) Explain the term *systematic error*.

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(1 mark)

2 (d) (ii) There may be a systematic error in this experiment because of friction in the pulleys. When the measurements were taken, increasing values of m were used. State and explain how friction in the pulleys would have affected the measured values of y.

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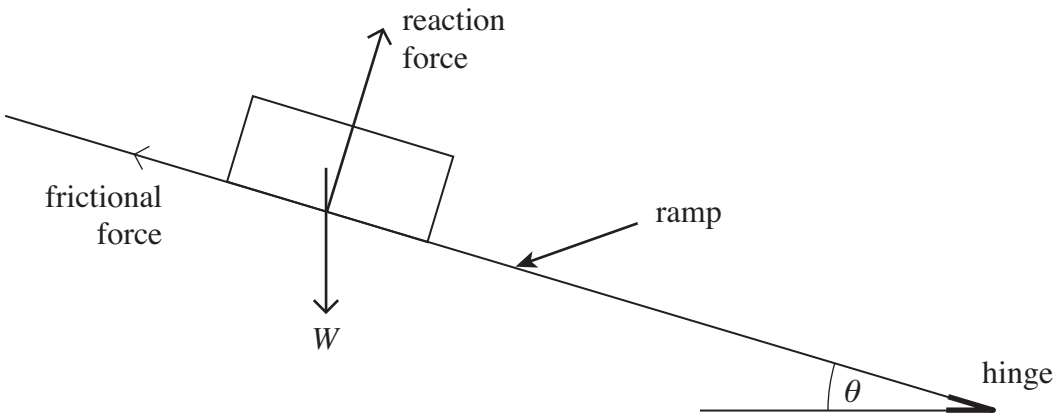
(2 marks)

16

3 **Figure 3** shows another system where three forces are in equilibrium.

Figure 3



A wooden box is at rest on a ramp at an angle θ to the horizontal. W is the weight of the box and its contents. The frictional force prevents the box sliding down the ramp. The reaction force acts on the box as shown. The ramp is hinged at its lower end so that it can be easily lifted to change the angle θ.

Describe how you would investigate the relationship between W and the angle, θ_s, at which the box just starts to slide down the ramp.

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(5 marks)

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END OF QUESTIONS