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 2014

Physics (Specification A & B) PHY3T/Q14/test

Unit 3T AS Investigative Skills Assignment (ISA) Q

For submission by 15 May 2014

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.	• 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 .....

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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 the experiment.

[1 mark]

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1 (b) (i) Estimate the uncertainty in your largest mean value of d and in your largest mean value of h.

[1 mark]

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Uncertainty in largest mean value of d = ...

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Uncertainty in largest mean value of h = ...

1 (b) (ii) Use your answers from part (b)(i) to calculate the uncertainty in the corresponding value of $\frac{d}{h}$.

[3 marks]

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1 (c) Explain what your graph indicates about the relationship between $\frac{d}{h}$ and $\sin\theta$.

[2 marks]

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1 (d) The general equation of a straight line graph is $y = mx + c$.

Theory shows that $n = \frac{h}{d}\sin\theta$

where n is a constant.

By rearranging the equation, show that the graph is predicted to be a straight line through the origin.

[2 marks]

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1 (e) State what is represented by the gradient of the graph.

[1 mark]

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1 (f) State **two** ways to decide whether your results are reliable or not.

[1 mark]

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Section B

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

2 In a similar experiment to the one in Stage 1, a student uses a protractor to measure the angle of refraction, θ_2, at the first surface of a transparent block, as well as the angle of incidence, θ_1.

The results are shown in **Table 1**.

Table 1

Angle of incidence, θ_1 / °	**Angle of refraction, θ_2 / °**	**$\sin\theta_1$**	**$\sin\theta_2$**
0.0	0.0	0.0	0.0
10.0	6.5	0.174	0.113
15.0	10.0	0.259	0.174
20.0	13.0	0.342	0.225
25.0	16.5	0.423	
30.0	19.5	0.500	
35.0	22.5	0.574	

2 (a) Complete **Table 1**.

[1 mark]

2 (b) Complete **Figure 1** on page 5 by plotting the three remaining points and draw a best fit straight line.

[2 marks]

2 (c) Determine the gradient of your graph (**Figure 1**).

[3 marks]

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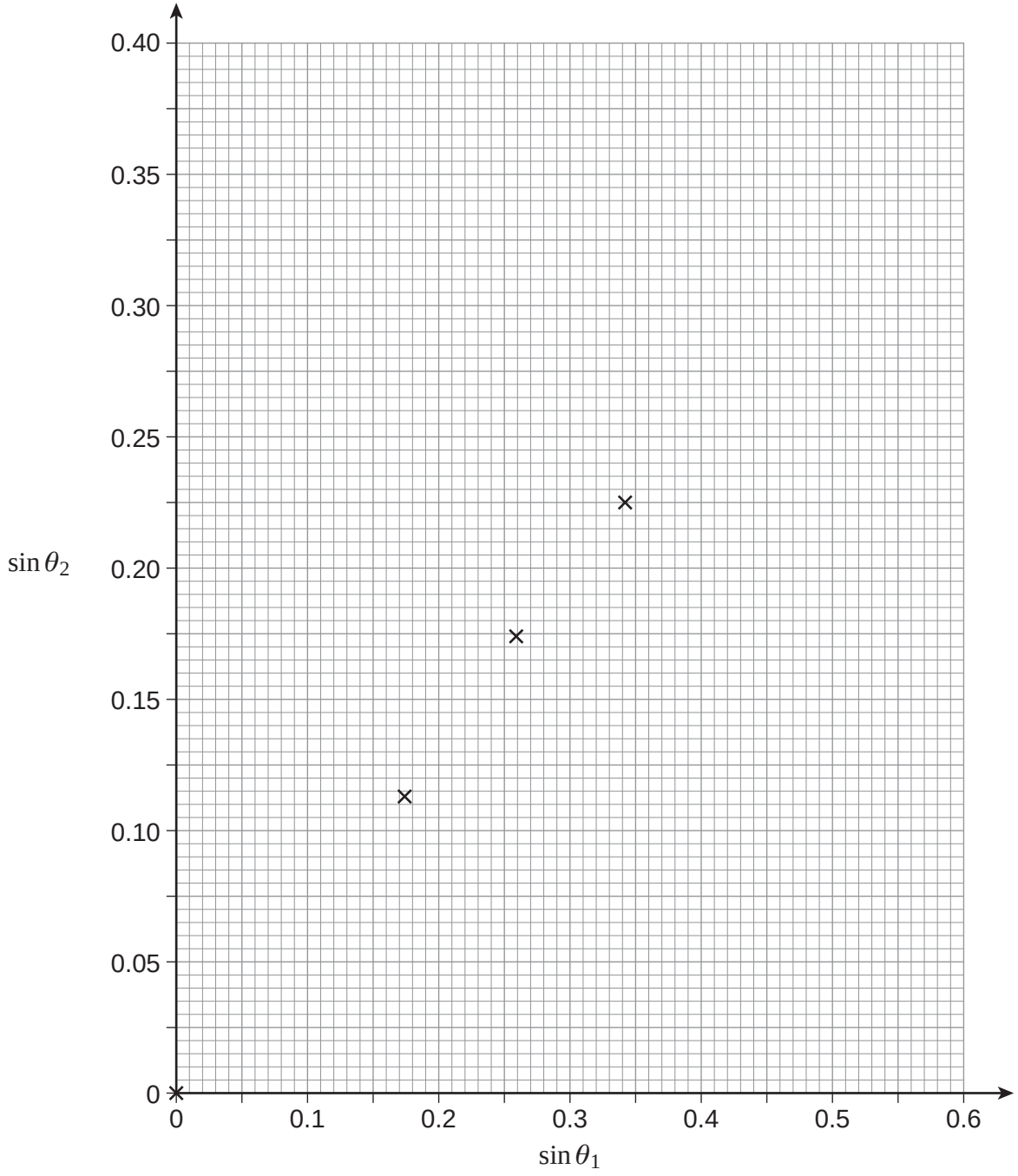
Figure 1



Do not write outside the box

2 (d) Theory shows that

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

2 (d) (i) Use your gradient from part 2(c) to determine the value of $\frac{n_2}{n_1}$ where n_2 is the refractive index of the material of the block, and n_1 is the refractive index of the air.

[2 marks]

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2 (d) (ii) The accepted value of this ratio for a type of glass is $1.62 \pm 2\%$. Discuss whether the transparent block in part (d)(i) is likely to be made of this type of glass.

[3 marks]

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2 (e) Give **two** ways in which the uncertainty in θ_1 and θ_2 could be reduced.

[2 marks]

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3 The angles are measured using a protractor to a precision of $\pm 0.5^{\circ}$.

3 (a) The angle, θ_2, is measured to be 19.5°.
State the possible maximum and minimum values of this angle.

[1 mark]

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3 (b) Calculate the corresponding range of the values of $\sin\theta_2$.

[1 mark]

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3 (c) Calculate the resulting percentage uncertainty in $\sin\theta_2$.

[1 mark]

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3 (d) Explain how the percentage uncertainty in $\sin\theta$ depends on θ for angles between 0° and 90°.

[1 mark]

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4

Do not write outside the box

4 (a) The refractive index of a glass block depends on the wavelength of light used. Describe an experiment which would allow you to investigate how the refractive index depends on the wavelength of light. You may assume you have a ray box that produces a narrow beam of white light and a selection of different coloured filters which transmit known wavelengths of light. You may also assume you have access to any other necessary equipment.

[3 marks]

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4 (b) Outline how you would use a diffraction grating to check the wavelength transmitted by each coloured light filter.

[3 marks]

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END OF QUESTIONS