Experimental Question 2: An Optical "Black Box"

MARKING SCHEME

a) 0.4	Writing the reflection law	0.1	
	Correct result	0.3	
b) 0.5	Correct answer	0.5	
c) 0.8	Value of φ	0.6	Partial credit for φ corresponding to the edge of the reflection pattern – 0.2
	Error estimation	0.2	0.02^o-0.1^o – Full credit of 0.2 0.11^o-0.5^o – Partial credit of 0.1
d) 0.5	Correct answer	0.5	
e) 1.4	Measuring the distance y between the sample and the bench	0.1	
	Choosing a large enough distance y	0.3	At least 70cm – 0.3 25cm-69cm – 0.1
	Distance x between two positions of the stake (or equivalent)	0.1	
	Calculating δ_0 from measurements	0.1	
	Value of δ_0	0.7	30.6^o-31.6^o - 0.7 30.3^o-32.0^o - 0.5 30.0^o-32.3^o - 0.3 29.6^o-32.7^o - 0.1
	Error estimation	0.1	
f) 1.4	Measuring the distance y between the sample and the bench	0.1	
	Choosing a large enough distance y	0.3	At least 70cm – 0.3 25cm-69cm – 0.1
	Distance x between two positions of the stake (or equivalent)	0.1	
	Calculating δ_{min} from measurements	0.1	
	Value of δ_{min}	0.7	30.4^o-31.0^o - 0.7 30.1^o-31.3^o - 0.5 29.8^o-31.6^o - 0.3 29.5^o-32.0^o - 0.1
	Error estimation	0.1	
g) 0.8	Writing equations for n	0.2	
	Extracting an expression for n	0.4	
	Using the correct angle of the prism	0.2	
h) 0.7	Value of n_v	0.3	1.601-1.607 - 0.3 1.595-1.613 - 0.2 1.574-1.634 - 0.1

	Error calculation	0.3	
	Value of the error	0.1	
i) 1.0	Measured distance y to the screen	0.1	
	Large enough range of points x on the screen	0.3	At least 20cm – 0.3 15cm-19cm – 0.2 10cm-14cm – 0.1
	Enough fringes	0.2	At least 8 fringes – 0.2 6-7 fringes – 0.1
	Correct counting	0.2	
	Converting distances to angles	0.2	
	Penalty for no errors in measurements	-0.1	
	Penalty for no errors in θ	-0.1	
j) 1.5	Graph	0.5	Correct axes (e.g. $\sin\theta$ vs. m), properly marked – 0.1 Reasonably linear – 0.3 Efficient use of the graph paper's area – 0.1
	Finding the slope	0.1	
	Error of the slope	0.1	
	Result for d	0.6	49.3μm-50.7μm - 0.6 48.5μm-51.5μm - 0.4 47μm-53μm - 0.2
	Calculation of error in d	0.1	
	Value of error in d	0.1	
k) 1.0	Measuring the deflection angle	0.3	Measuring the distance x along the screen or counting fringes – 0.1 Deducing the angle – 0.2
	Value of n_r	0.5	1.577-1.581 - 0.5 1.573-1.585 - 0.3 1.567-1.590 - 0.2 1.550-1.610 - 0.1
	Calculation of error in n_r	0.1	
	Value of error in n_r	0.1	