

**Marking scheme**  
**(minimal score 0.1pt)**

Marker \_\_\_\_\_

Student \_\_\_\_\_

TOTAL \_\_\_\_\_

Task	Criteria	Max. points	Marker	Consensus
A1	$c(t) = c_0 + C \exp\left(-\frac{t}{\tau}\right)$ $\tau = \frac{3Vh}{pS_0vd}$	0.4  0.3		
A2	A fan was used to increase convection rate outside the vessel.	0.5		
A3	$c_0$ is measured	0.3		
A4	Number of points $c(t)$ measured: 0.05 for each measurement with $c > 0.2\%$ (not more than 0.7 total) Time $\Delta t > 2000 \text{ sec}$ $\Delta t > 1000 \text{ sec}$	0.7   0.2 (0.1)		
A5	<b>Linearized Graph:</b> Axis labeled and scaled 0.05 for each experimental points plotted (not more than 0.7 total) Approximating curve shown	0.2 0.7 0.3		
A6	$\tau = \tau_{\text{individual}} \pm 200 \text{ sec}$	1.0		
A7	Error analysis	0.4		
<b>Part A total</b>		<b>5.0</b>		
B1	$(m - 1/2)\lambda = 2h\sqrt{n^2 - \sin^2 \theta}$ – reflectance maxima $m\lambda = 2h\sqrt{n^2 - \sin^2 \theta}$ – reflectance minima If reflection phase change is not taken into account	1.0   (0.8)		
B2	Measurements Zero was set with use of reflected laser beam or measurements taken symmetrically. Number of minima and maxima observed, 0.2 each, not more than 2.8. Angles of all minima are not necessary, only the number of minima between two angles should be calculated.	0.5  2.8		
B3	$h \in [71; 79] \mu\text{m}$ $h \in [67; 83] \mu\text{m}$ $h \in [60; 94] \mu\text{m}$ $h \in [49; 115] \mu\text{m}$ If result is wrong due to incorrect equation, derived	1.7 (1.2) (0.8) (0.4)		

	in B1, half of points will be given			
	<b>Part B total</b>	<b>6.0</b>		
C1	Theory $\Delta n^* = \sin^2 \beta \Delta n$ $\delta = \frac{h}{\cos \beta} \Delta n^*$ $\delta = \frac{h}{\cos \beta} \sin^2 \beta \Delta n$	0.5 1.0 1.0		
C2	Description of an appropriate experimental setup	0.6		
C3	Measurements Data is measured after zero calibration with use of reflected beam 0.3 for each transmittance extremum observed (not more than 3) If the angle of maximum intensity is determined by eye - 0.1 0.3 for each correct value of $\delta$ in extremum (not more than 3)	0.5 0.4x3 0.3x3		
C4	Value of $\Delta n$ [0.035; 0.040] [0.030; 0.045] If wrong $\Delta n$ was obtained due to wrong $h$ , full points will be given	1.0 (0.5)		
C5	Porosity $p$ is calculated correctly from the graph	0.3		
	<b>Part C total</b>	<b>7.0</b>		
D1	Thermal velocity of $CO_2$ is calculated [350; 430] m/s	0.2		
D2	Volume of the vessel is measured [190; 240] $cm^3$ If the volume of fan and sensor taken in account	0.2 0.1		
D3				
D4	$d$ is calculated correctly from previously measured $\tau$ , $h$ and $p$ .	0.5		
D5	$d \in [2; 10] \text{ nm}$ $d \in [1; 20] \text{ nm}$ If one gets the right answer because of error in calculations, no points are given.	1.0 (0.5)		
	<b>Part D total</b>	<b>2.0</b>		