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

Marker _____ Student _____

**TOTAL _____**

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

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