SOLUTION OF EXPERIMENT PROBLEM 2

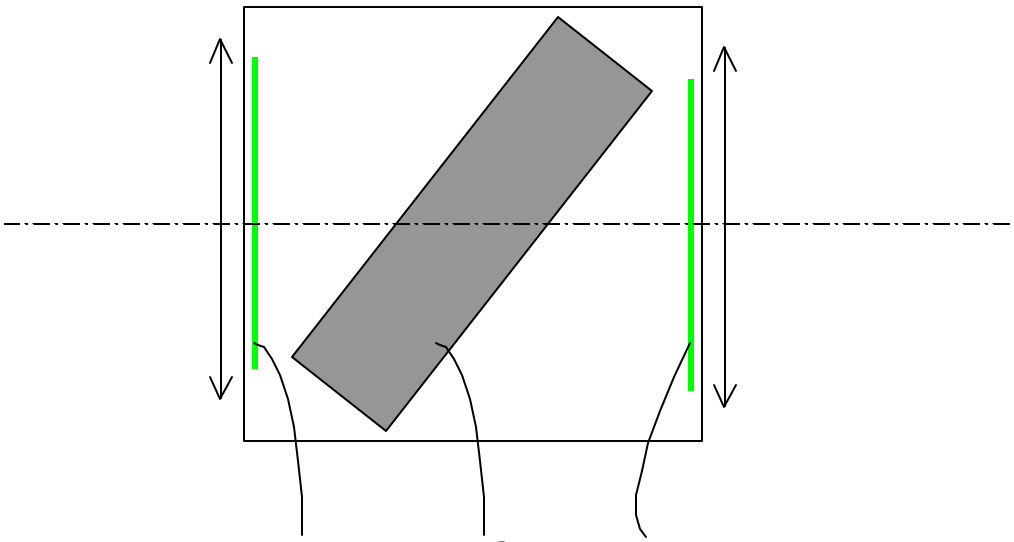
1. The optical components are **[total 1.5 pts]**:

   no.1 Diffraction grating [***0.5 pts***]

   no.2 Diffraction grating [***0.5 pts***]

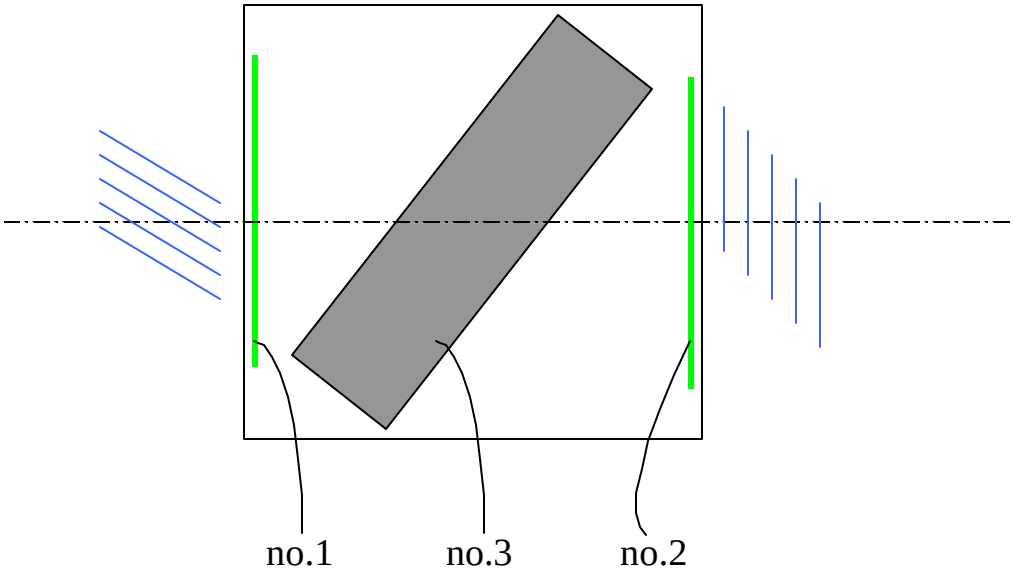
   no.3 Plan-parallel plate [***0.5 pts***]

2. Cross section of the box **[total 1.5 pts]**:



[***0.5 pts***] [***0.5 pts***] [***0.5 pts***]

3. Additional information **[total 1.0 pts]**:



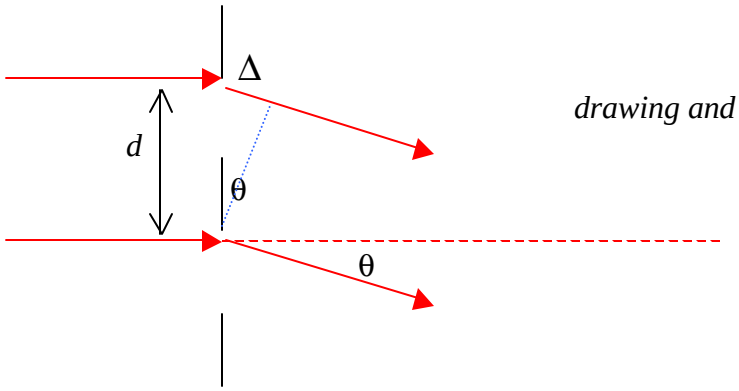
Distance of the grating (no.1) to the left wall is practically zero [***0.2 pts***]

Distance of the grating (no.2) to the right wall is practically zero [***0.2 pts***]

Lines of grating no.1 is at right angle to the slit [***0.3 pts***]

Lines of grating no. 2 is parallel to the slit [***0.3 pts***]

4. Diffraction grating **[total 2.0 pts]**:



drawing and labels should be complete **[*0.6 pts*]**

Path length difference:

$\Delta = d \sin\theta$, d = spacing of the grating

Diffraction order:

$\Delta = m\lambda$, m = order number

Hence, for the first order (m = 1):

$\sin\theta = \lambda / d$ **[*0.4 pts*]**

Observation data:

tan θ	θ	sin θ
0.34	18.78^0	0.3219
0.32	17.74^0	0.3048
0.32	17.74^0	0.3048

number of data ³ 3

[*0.5 pts*]

Name of component no.1	Specification
Diffraction grating	Spacing = 2.16 μm Lines at right angle to the slit

[*0.4 pts*]

[*0.1 pts*]

Note: true value of grating spacing is 2.0 μm, deviation of the result ≤ 10%

5. Diffraction grating **[total 2.0 pts]**:

For the derivation of the formula, see nr.4 above.

[***1.0 pts***]

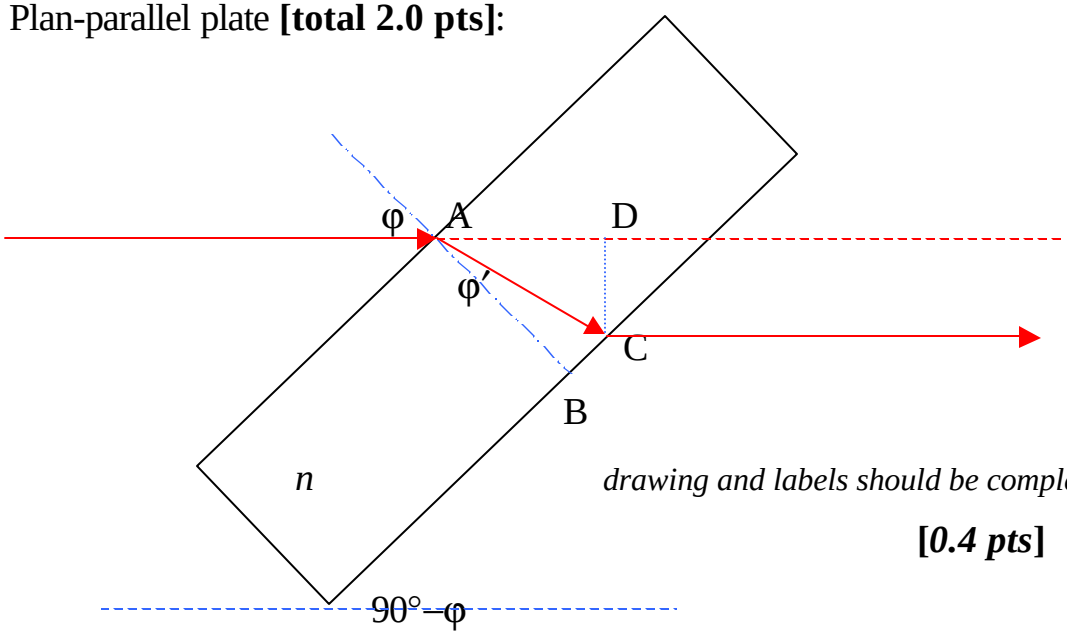
Observation data:

tanθ	θ	sinθ	
1.04	46.12^0	0.7208	
0.96	43.83^0	0.6925	*number of data ³ 3*
1.08	47.20^0	0.7330	[***0.5 pts***]

Name of component no.2	Specification	
Diffraction grating	Spacing = 0.936 μm	**[*0.4 pts*]**
	Lines parallel to the slit	**[*0.1 pts*]**

Note: true value of grating spacing is 1.0 μm, deviation of the result ≤ 10%

6. Plan-parallel plate **[total 2.0 pts]**:



drawing and labels should be complete

[0.4 pts]

Snell's law:

$\sin\varphi = n \sin\varphi'$, $\varphi' = \angle BAC$

Path length inside the plate:

$AC = AB / \cos\varphi'$, $AB = h$ = plate thickness

Beam displacement:

$CD = t = AC \sin\angle CAD$, $\angle CAD = \varphi - \varphi'$

Hence:

$$t = h \sin\varphi \left[1 - \cos\varphi / (n^2 - \sin^2\varphi)^{1/2} \right]$$ [***0.6 pts***]

Observation data:

φ	t	
0	0	(angle between beam and axis 49°)
49^0	7.3 arbitrary scale	[***0.5 pts***]

Name of component no.3	Specification	
Plane-parallel plate	Thickness = 17.9 mm	***[0.2 pts]***
	Angle to the axis of the box 49°	***[0.3 pts]***

Note: - true value of plate thickness is 20 mm
- true value of angle to the axis of the box is 52°
- deviation of the results ≤ 20%.