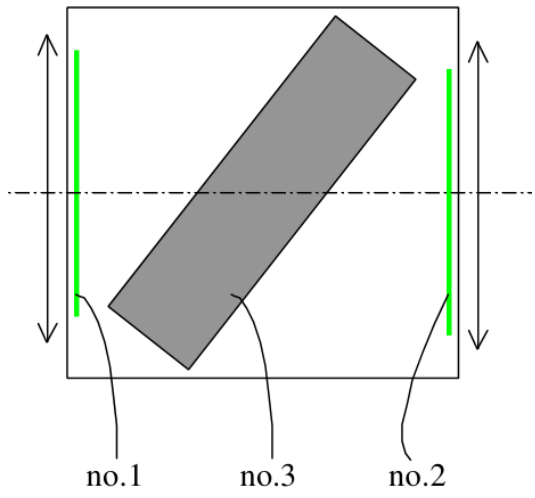
SOLUTION OF EXPERIMENT PROBLEM 2

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

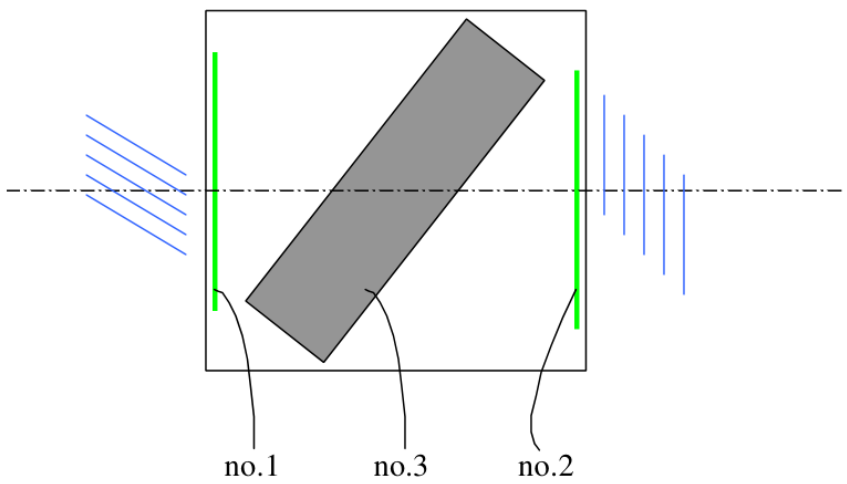
no.1	Diffraction grating	[***0.5 pts***]
no.2	Diffraction grating	[***0.5 pts***]
no.3	Plan-parallel plate	[***0.5 pts***]

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]**:



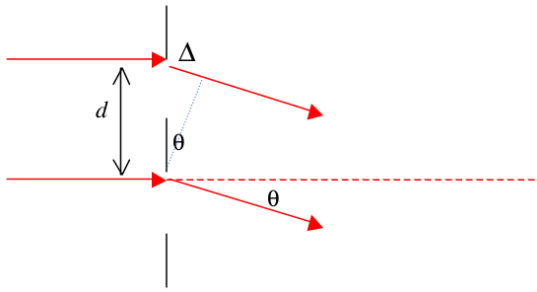
Distance of the grating (no.1) to the left wall is practically zero [***0.2 pts***]

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

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

$$\Delta = d \sin\theta\,, \qquad d = \text{spacing of the grating}$$

Diffraction order:

$$\Delta = m\lambda\,, \qquad m = \text{order number}$$

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

$$\sin\theta = \lambda/d$$

[***0.4 pts***]

Observation data:

$\tan\theta$	θ	$\sin\theta$
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
[***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 $\leq 10\%$

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

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

[***1.0 pts***]

Observation data:

$\tan\theta$	θ	$\sin\theta$
1.04	46.12^0	0.7208
0.96	43.83^0	0.6925
1.08	47.20^0	0.7330

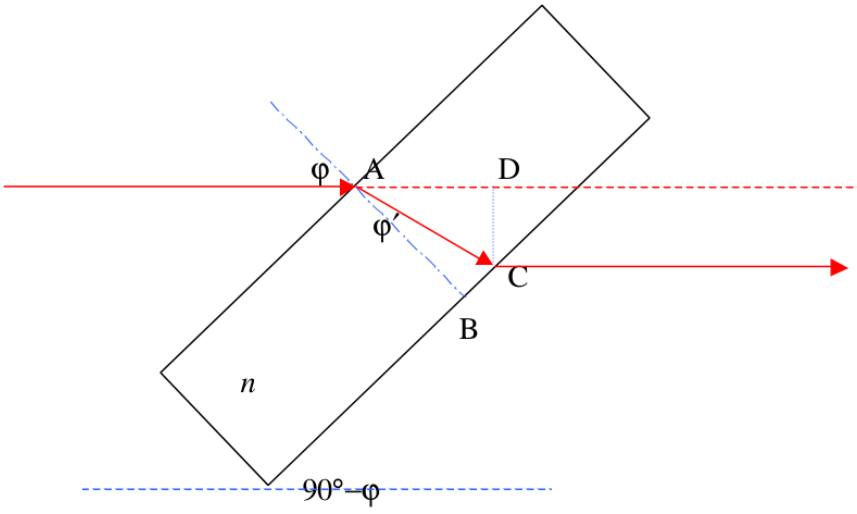
number of data ≥ 3
[***0.5 pts***]

Name of component no.2	Specification
Diffraction grating	Spacing = 0.936 μm Lines parallel to the slit

[***0.4 pts***]
[***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:

$$\sin\varphi = n\sin\varphi', \qquad \varphi' = \angle\mathrm{BAC}$$

Path length inside the plate:

$$\mathrm{AC} = \mathrm{AB}/\cos\varphi', \qquad \mathrm{AB} = h = \text{plate thickness}$$

Beam displacement:

$$\mathrm{CD} = t = \mathrm{AC}\sin\angle\mathrm{CAD}, \qquad \angle\mathrm{CAD} = \varphi - \varphi'$$

Hence:

$$t = h\sin\varphi\,[\,1 - \cos\varphi/(n^2 - \sin^2\varphi)^{1/2}\,]$$

[***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 Angle to the axis of the box 49°

[***0.2 pts***]
[***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 $\leq 20\%$.