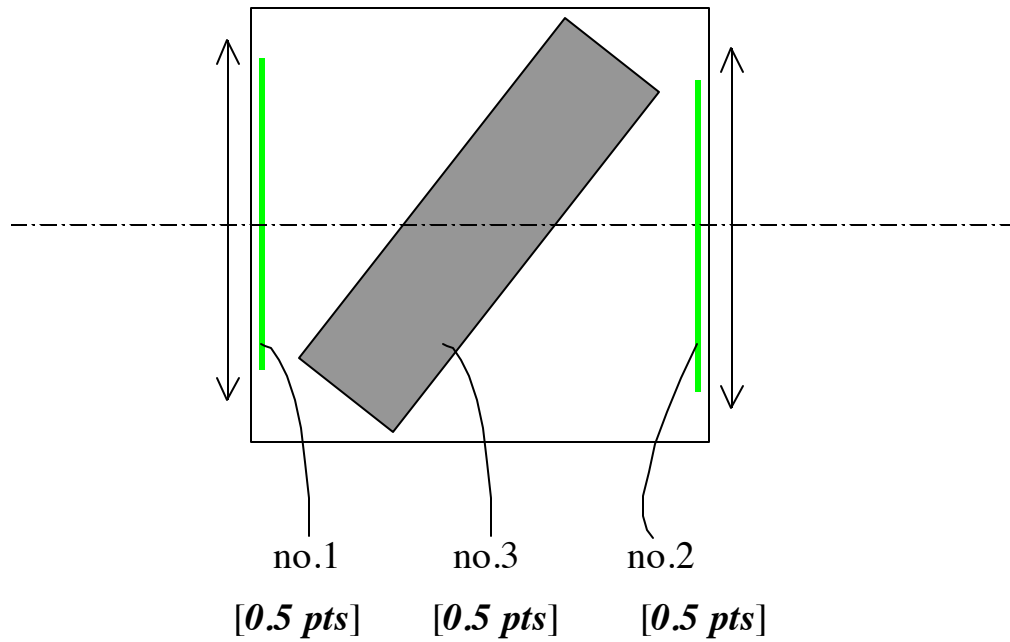


## SOLUTION OF EXPERIMENT PROBLEM 2

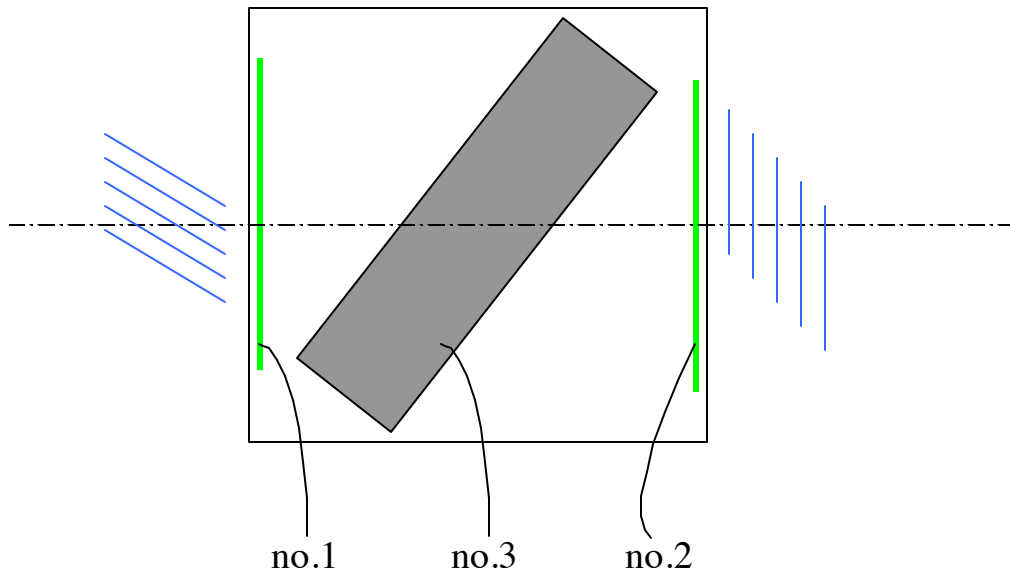
1. The optical components are **[total 1.5 pts]**:

- |      |                     |                  |
|------|---------------------|------------------|
| no.1 | Diffraction grating | <b>[0.5 pts]</b> |
| no.2 | Diffraction grating | <b>[0.5 pts]</b> |
| no.3 | Plan-parallel plate | <b>[0.5 pts]</b> |

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



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



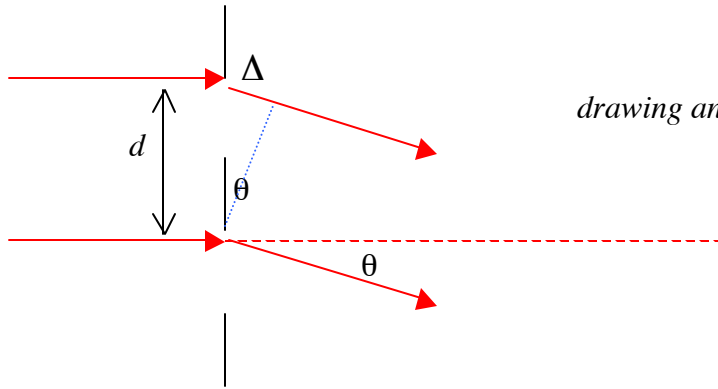
Distance of the grating (no.1)  
to the left wall is practically zero  
**[0.2 pts]**

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:

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

Diffraction order:

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

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

$$\sin \theta = \lambda / d \quad [0.4 \text{ pts}]$$

Observation data:

$\tan \theta$	$\theta$	$\sin \theta$
0.34	$18.78^\circ$	0.3219
0.32	$17.74^\circ$	0.3048
0.32	$17.74^\circ$	0.3048

*number of data  $\geq 3$*

[0.5 pts]

Name of component no.1	Specification
Diffraction grating	Spacing = $2.16 \mu\text{m}$ Lines at right angle to the slit

[0.4 pts]

[0.1 pts]

Note: true value of grating spacing is  $2.0 \mu\text{m}$ , 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:

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

*number of data  $\geq 3$*

**[0.5 pts]**

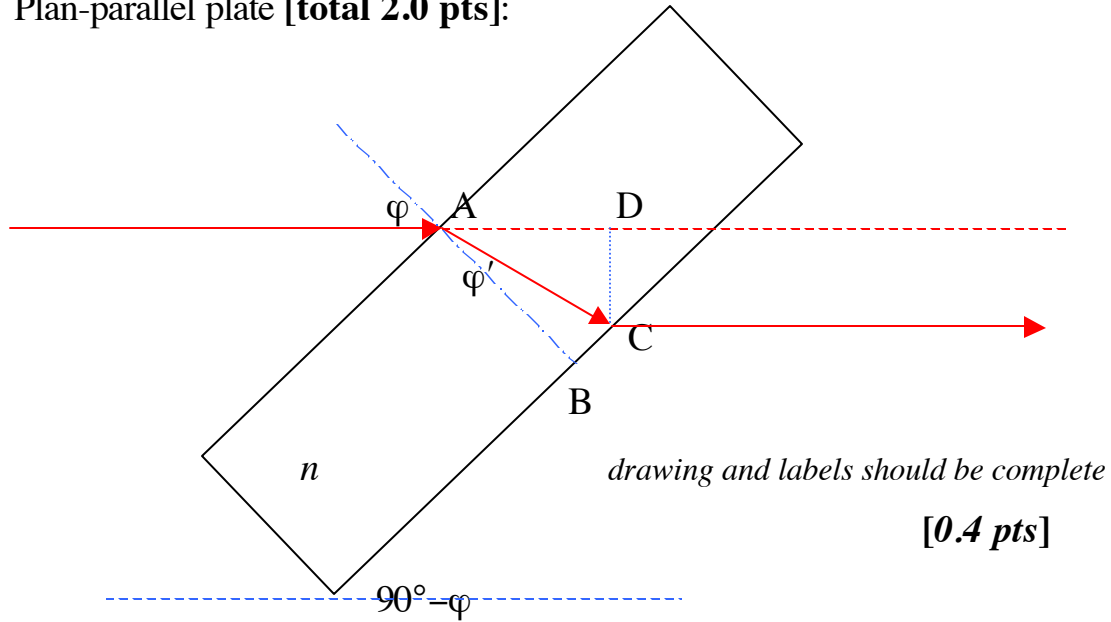
Name of component no.2	Specification
Diffraction grating	Spacing = 0.936 $\mu\text{m}$ Lines parallel to the slit

**[0.4 pts]**

**[0.1 pts]**

Note: true value of grating spacing is 1.0  $\mu\text{m}$ , deviation of the result  $\leq 10\%$

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



Snell's law:

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

Path length inside the plate:

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

Beam displacement:

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

Hence:

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

Observation data:

$\varphi$	$t$
0	0 (angle between beam and axis $49^\circ$ )
$49^\circ$	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 $49^\circ$

[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  $52^\circ$   
 - deviation of the results  $\leq 20\%$ .