

## Exercises for Experimental Physics 3 – IPSP

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### Exercise Sheet 8 (WS 2012/13)

Date of Issue to Students: Nov. 30<sup>th</sup> 2012

**Date of Submission: Dec. 7<sup>th</sup> 2012**

**Submission Place:** Marked mailbox next to room 302 (Linnestr. 5)

**Submission Time:** 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper. Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

#### Exercises:

1. A ray of light begins at the point  $(-2.00 \text{ m}, 2.00 \text{ m}, 0.00 \text{ m})$ , strikes a mirror in the  $y = 0$  plane at some point  $(x, 0, 0)$ , and reflects through the point  $(2.00 \text{ m}, 6.00 \text{ m}, 0.00 \text{ m})$ .  
(a) Find the value of  $x$  that makes the total distance traveled by the ray a minimum.  
(b) What is the angle of incidence on the reflecting plane? (c) What is the angle of reflection?  
(8 Points)
2. To produce a polarized laser beam a plate of transparent material, (Figure 1) is placed in the laser cavity and oriented so the light strikes it at the polarizing angle. Such a plate is called a Brewster window. Show that if  $\theta_{p1}$  is the polarizing angle for the  $n_1$  to  $n_2$  interface, then  $\theta_{p2}$  is the polarizing angle for the  $n_2$  to  $n_1$  interface. (7 Points)
3. A light ray passes through a prism with an apex angle of  $\alpha$ , as shown in Figure 2. The ray and the bisector of the apex angle bisect at right angles. Show that the *angle of deviation*  $\delta$  is related to the apex angle and the index of refraction of the prism material by  $\sin\left[\frac{1}{2}(\alpha + \delta)\right] = n \sin\left(\frac{1}{2}\alpha\right)$ . (5 Points)
4. Show that the angle of deviation  $\delta$  is a minimum if the angle of incidence is such that the ray and the bisector of the apex angle  $\alpha$  (Figure 2) intersect at right angles.

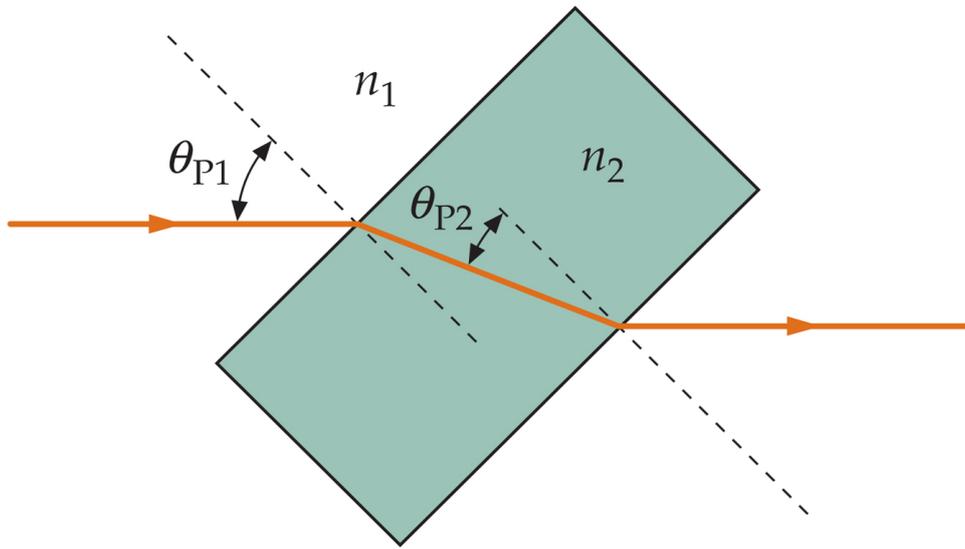


Figure 1: Exercise 2

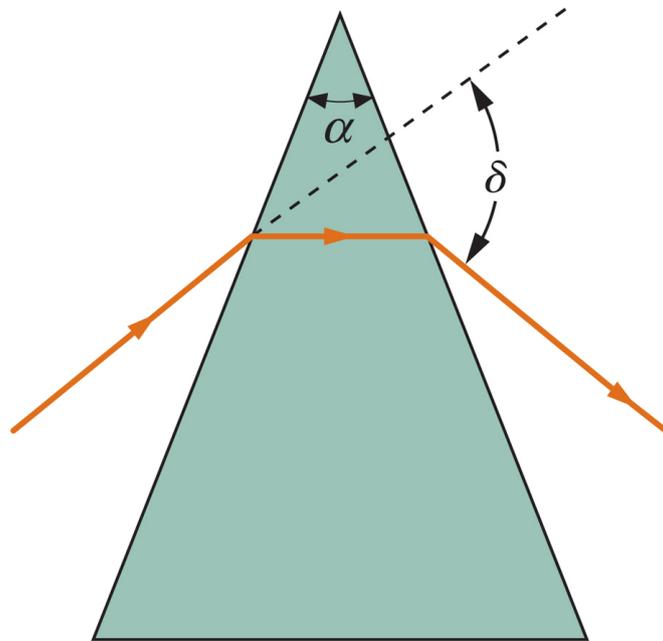


Figure 2: Exercise 3 and 4