

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 8 (WS 2012/13)

Date of Issue to Students: Nov. 30th 2012

Date of Submission: Dec. 7th 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 θ_{p1} is the polarizing angle for the n_1 to n_2 interface, then θ_{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 α , as shown in Figure 2. The ray and the bisector of the apex angle bisect at right angles. Show that the *angle of deviation* δ 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 δ is a minimum if the angle of incidence is such that the ray and the bisector of the apex angle α (Figure 2) intersect at right angles.

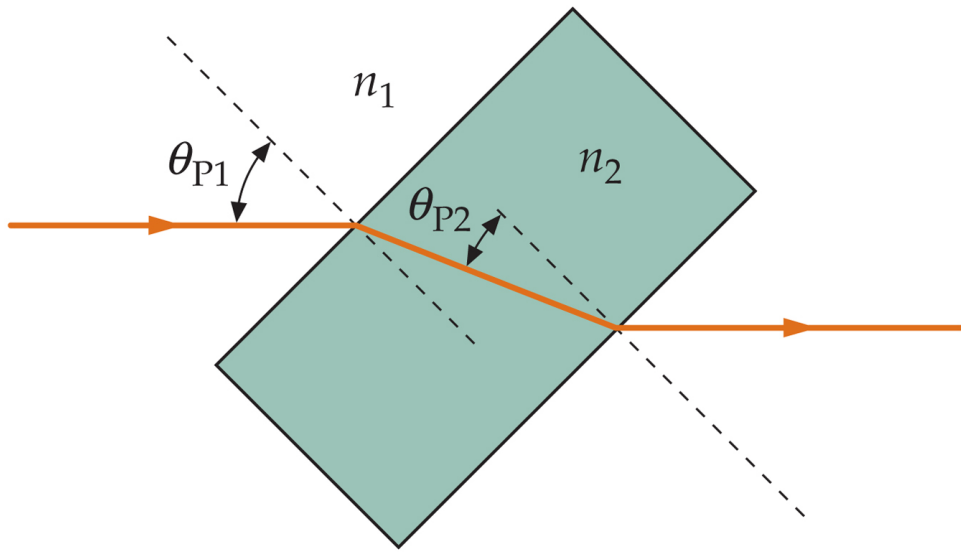


Figure 1: Exercise 2

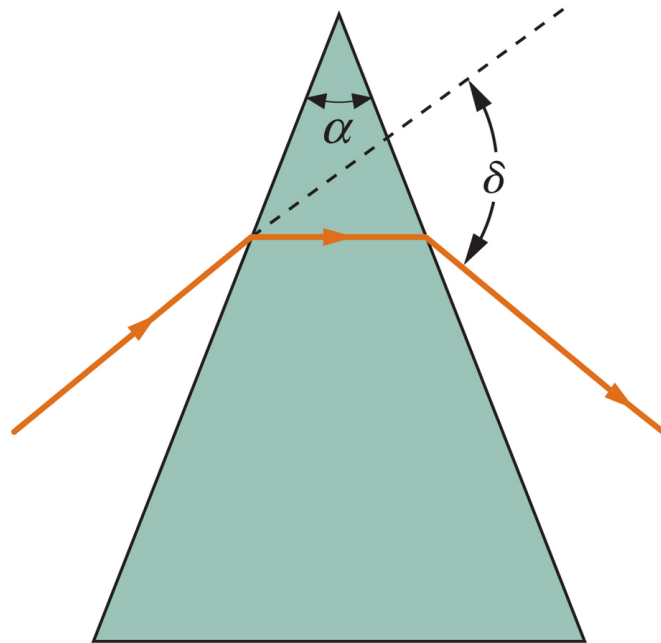


Figure 2: Exercise 3 and 4