

Exercises and Complements for the Introduction to Physics II

for Students

of Biology, Pharmacy and Geoscience

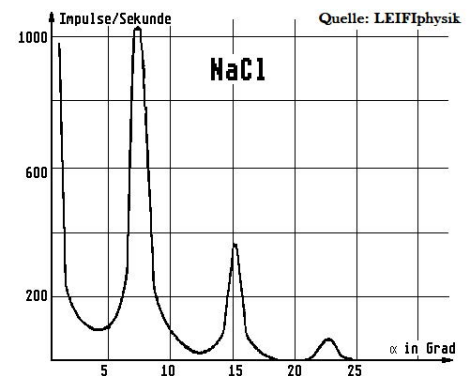
Sheet 9 / 29.04.2021

Zoom - Q&A on the Exercises: **11.05.2021/12.05.2021**

Exercise 33.

In order to determine the lattice spacing of a NaCl crystal, it is irradiated with Röntgen-light of wavelength $\lambda = 7 \cdot 10^{-11}$ m. The spectrum shown in the figure is obtained by measuring the reflected radiation.

Determine the lattice spacing of the NaCl crystal from the position of the maxima.



Exercise 34.

A microscope is an optical tool used for the magnification of small objects such as a cell. Our microscope has an objective of focal length $f_2 = 1.2$ cm and an eyepiece of focal length $f_1 = 2.0$ cm, which can be separated by a maximum of 20 cm. The clear viewing distance of the observer is $s_0 = 0.25$ m.

- (a) How large is the theoretical magnification?
- (b) What focal length would the eyepiece need to have in order to obtain a $100\times$ magnification?
- (c) We would like to observe the sting of a honey bee with a microscope. The sting has a length of 2.5 mm. What focal length must the objective have such that the bee sting is magnified to a length of 18.75 mm?

Hint: The distance a between the lenses is $a = s + f_1 + f_2$, where s is the tube length.

Exercise 35.

White light is shone onto a grating with 1000 transparent slits per cm.

- (a) At which angle does the 1st order maximum of red light ($\lambda = 650 \text{ nm}$) appear?
- (b) What is the maximum diffraction order of red light that can be produced with this arrangement?
- (c) Using the above grating, find the 1st order maxima of two other lines at angles of 2.46° and 3.15° . What are their wavelengths?

Exercise 36.

The labelling of a double slit for optical experiments is no longer recognizable. Therefore, the slit distance a is to be determined experimentally with a laser ($\lambda = 633 \text{ nm}$). The distance d between the screen and double slit is 1700 mm. A distance of 26 mm can be measured between the 4th order maxima.

Sketch the experimental setup and calculate the slit distance a using the small angle approximation ($\sin \alpha = \tan \alpha$).

Answers:

Exercise 33. $2.7 \cdot 10^{-10} \text{ m}$

Exercise 34. (a) 175 (b) 3.2 cm (c) 11.3 cm

Exercise 35. (a) 3.73° (b) 15 (c) 429.2 nm und 549.5 nm

Exercise 36. $331.1 \mu\text{m}$