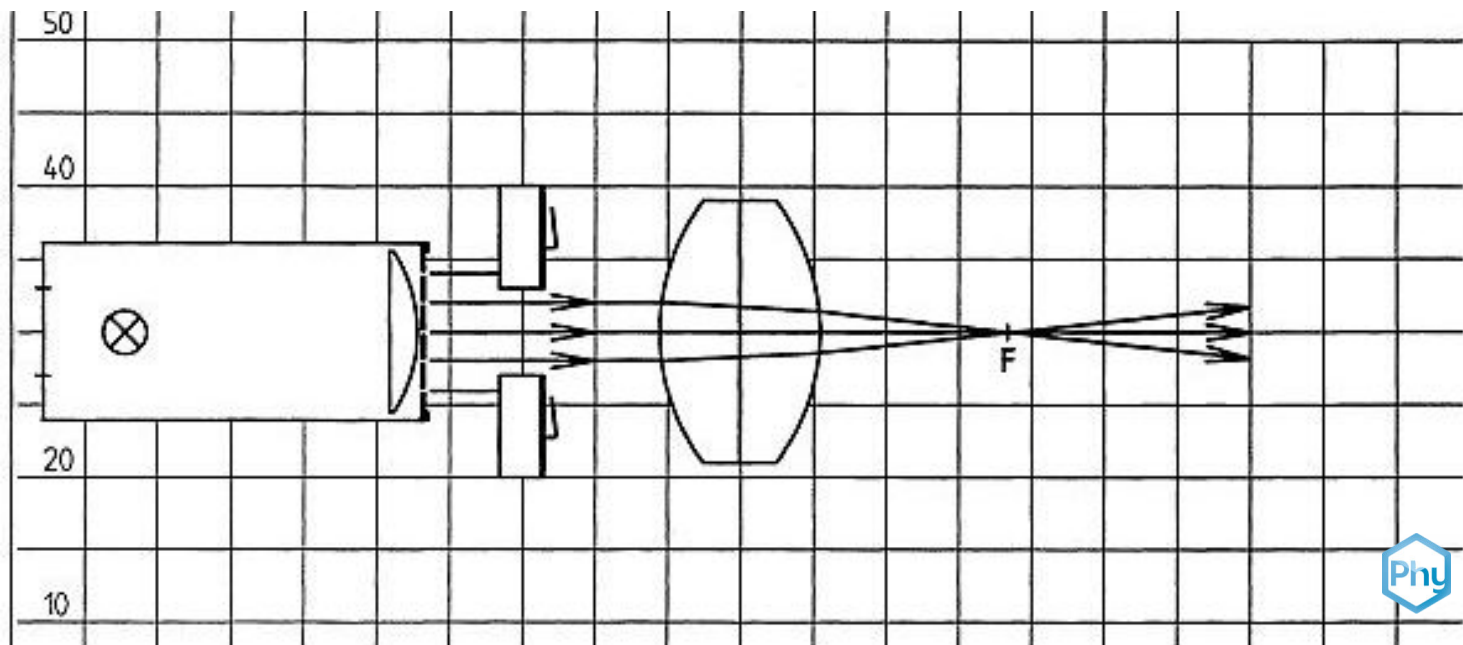


Spherical aberration



Spherical lens aberration

Physics

Light & Optics

Optical devices & lenses



Difficulty level

easy



Group size

-



Preparation time

10 minutes



Execution time

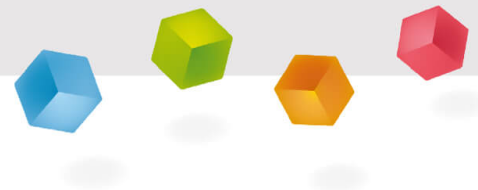
10 minutes

This content can also be found online at:



<http://localhost:1337/c/64724cffe1994e000281c79b>

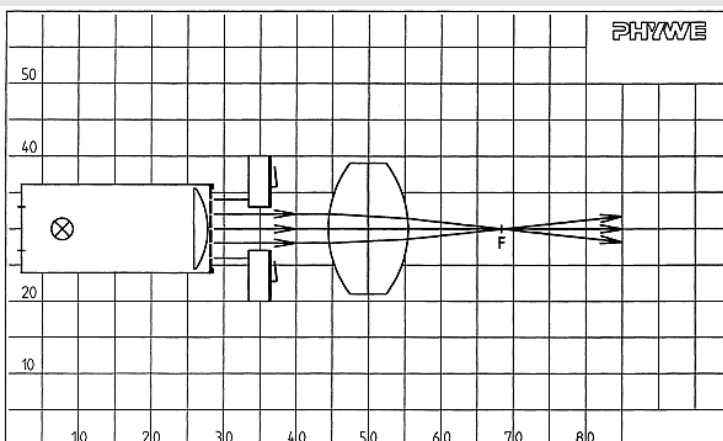
PHYWE



Teacher information

Application

PHYWE



Experimental set-up:

5-slit aperture with biconvex lens

The experiment below is designed to show and explain spherical lens aberrations to the students.

Spherical lens aberrations occur because the rays are refracted more strongly at the edge of the lens.

This results in a minimally deviating focal length, depending on whether rays pass through the lens centrally or at the edge.

Other teacher information (1/2)

PHYWE

Prior knowledge



Students need prior knowledge of converging and diverging lenses, as well as their behaviour under different light beam incidence.

Principle



Demonstrate that spherical lens aberration occurs for off-axis rays and how to reduce it.

Other teacher information (2/2)

PHYWE

Learning objective



Students should develop a sound knowledge of image construction.

Tasks



The students should observe the experiment and learn which concepts and properties are of high importance for the construction of the image.

Additional teacher information

PHYWE

Note



The use of the 5-slit aperture has the advantage that the intersections of the beams can be made out very clearly.

Man can also carry out the experiment with the wide parallel light beam provided by the adhesive luminaire.

Safety instructions

PHYWE



- The general instructions for safe experimentation in science lessons apply to this experiment.

PHYWE



Student information

Motivation

PHYWE



Reading magnifier

A reading magnifier is an object that only becomes interesting and important for most people when they reach retirement age.

As you can see in the picture, the magnifying glass does not really magnify the words evenly.

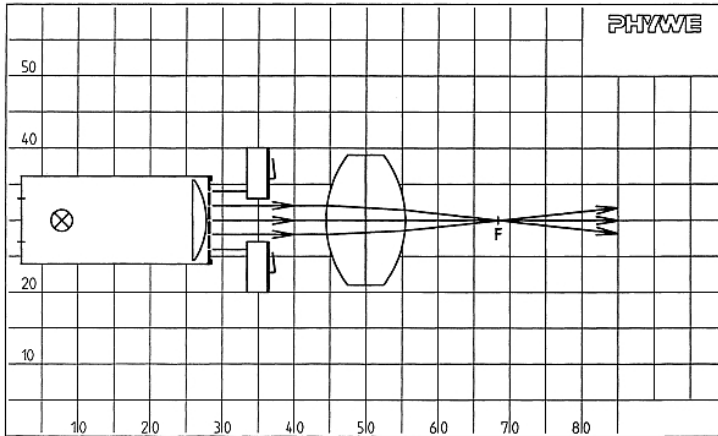
The words at the edge of the magnifying glass appear very blurred. Here you can see spherical lens aberrations, the underlying experiment should explain how these occur.

Equipment

Position	Material	Item No.	Quantity
1	PHYWE Demo Physics board with stand	02150-00	1
2	Halogen lamp for experiments, 12V/50W, with magnetic base	08270-20	1
3	Opt. block, planoconvex, magn.held	08270-02	2
4	Diaphragm w. holder, magnet held	08270-10	2
5	PHYWE Multitap transformer DC: 2/4/6/8/10/12 V, 5 A / AC: 2/4/6/8/10/12/14 V, 5 A	13533-93	1
6	G-clamp	02014-01	2

Set-up and Procedure (1/2)

PHYWE

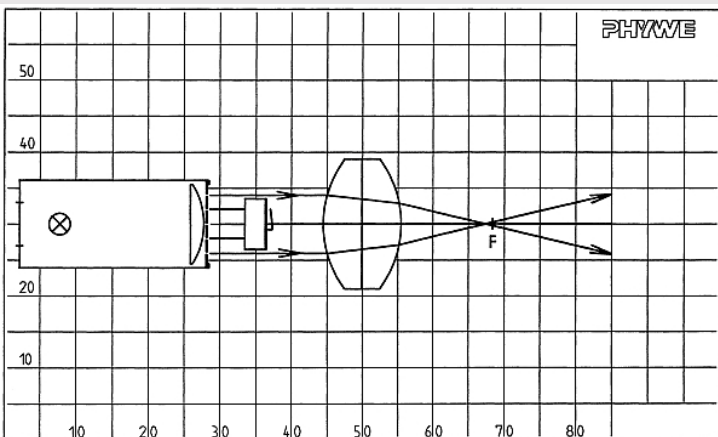


5-slit aperture with biconvex lens

- Draw optical axis on adhesive board
- Position the luminaire with the 5-slit aperture so that the centre beam runs along the optical axis.
- Adjust biconvex lens from the two model bodies on optical axis
- Use the diaphragms to block the outermost rays; mark focal point F

Set-up and Procedure (2/2)

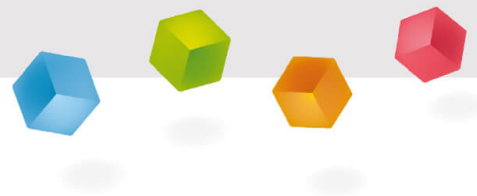
PHYWE



5-slit aperture with biconvex lens

- Stop the three central rays with an aperture; compare the current position of the intersection of the rays with the optical axis with the position of F.
- Use all 5 beams and look at "focal point".

PHYWE



Report

Task 1

PHYWE

Put the correct words into the gaps!

parallel rays intersect at a on the optical
 that is closer to the than the where
the rays closer to the axis intersect.

focal point

lens

Axis-distant

axis

point

☒ Check

Task 2

PHYWE

Another word for the spherical lens aberration shown in the experiment is aberration.

☐ True☐ False☒ Check

Spherical aberration is unimportant in technical repairs and can be neglected.

☐ True☐ False☒ Check

Task 3

PHYWE



The distance between the two determined focal points is approximately

Slide	Score / Total
Slide 13: Off-axis parallel beams	0/5
Slide 14: Multiple tasks	0/2
Slide 15: Distance focal points	0/3

Total  0 / 10

 Solutions

 Repeat