Determining the magnification of a concave lens

Physics > Light & Optics > Optical devices & lenses

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/62dbce3da52f910003dffb99

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Teacher information

Application

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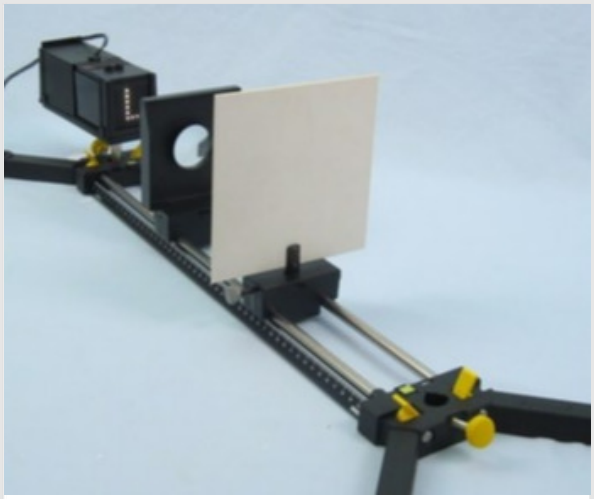

Experimental setup

Convex lenses, also called converging lenses, can produce a magnified image. They are an important element of ray optics and are therefore widely used in optical instruments and in camera lenses.

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Other teacher information (1/4)

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Principle

Incident light that is parallel to the optical axis is focused by the convex lens at the focal point. This can produce a magnified real image.

Learning objective

Students should observe the optical effect of a convex lens and calculate the magnification of the lens $b/g = B/G$.

Other teacher information (2/4)

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Task

- Students should investigate the relationship between the width of the object g, the image width b, the object size G and the image size B in the case of images through convex lenses.
- For this purpose, for different object widths g the other variables are measured and noted in the table in the report.

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Other teacher information (3/4)

Obtaining the equation for the magnification by theoretical means generally presents few difficulties. It is therefore advisable to use the experiment as a confirmation experiment. In this way, the students have sufficient goal orientation and know from the outset that the important thing is to find the two quotients B/G and b/g by calculation and to compare them after the four occurring variables have been determined experimentally.

Other teacher information (4/4)

Notes on set-up and procedure

- With the available scale for the stand bench, it is possible to measure all four sizes. However, it is easier to measure if the scale is applied to the front stand rod and only the distances g and b are measured with it. Item size G and image size B can be measured more conveniently with an additional ruler.
- The choice of convex lens $f = +100\,\mathrm{mm}$ ensures that the entire length of the optical bench can be used for image generation without producing images that are too large or too small. In addition, with this lens you also get magnified images that are still very sharp, so that quite accurate measurements become possible. When using the lens $f = 5\,\mathrm{mm}$, this is not the case, as lens aberrations have a very strong effect.

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Safety instructions

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

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Student information

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Motivation

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Spectacle lenses as an example of a convex lens

Convex lenses, also called converging lenses, can produce a magnified image. They are a central component of optics and are therefore often found in everyday devices, such as telescopes, camera lenses or even eyeglasses.

Tasks

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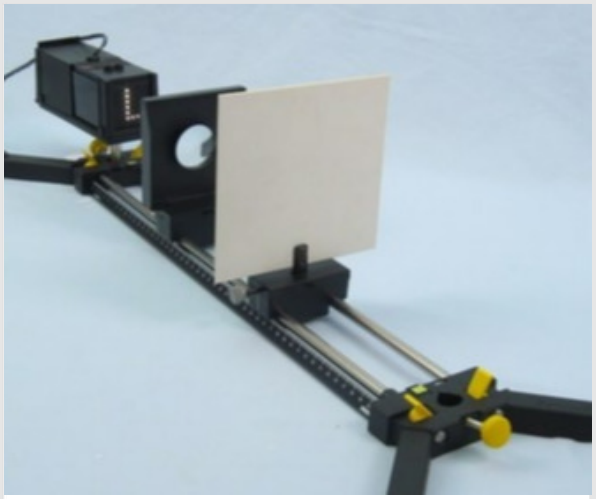

Experimental setup

- Investigate the relationship between the width of the object g , the image width b the object size G and the image size B in the case of images through convex lenses.
- For this purpose, you should measure the other sizes for different object widths g and note them in the table in the report.

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Equipment

Position	Material	Item No.	Quantity
1	Optical profile-bench for student experiments, l = 600 mm	08376-00	1
2	Light box, halogen 12V/20 W	09801-00	1
3	Bottom with stem for light box	09802-20	1
4	Lens on slide mount, f=+100mm	09820-02	1
5	Slide mount for optical bench	09822-00	1
6	Screen, white, 150x150 mm	09826-00	1
7	Object -L-, glass bead	11609-00	1
8	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up (1/3)

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- Assemble the optical bench from the two tripod rods and the variable tripod foot and place the scale on the front tripod rod.
- Place the base with stem under the light box.




Set-up (2/3)

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- Clamp the light box in the left part of the tripod base so that the lens side faces away from the optical bench.
- Slide an opaque shade in front of the lens and the Perl-L into the shaft at the other end of the luminaire.


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Set-up (3/3)

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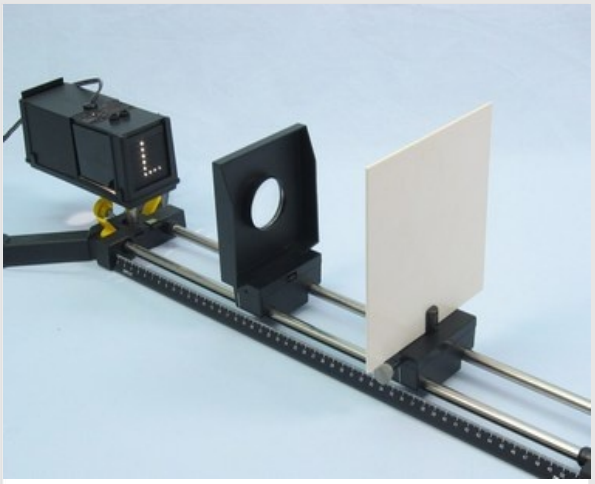

Experimental setup

- Place the lens and, with the help of the slide, the screen on the optical bench.

Procedure (1/3)

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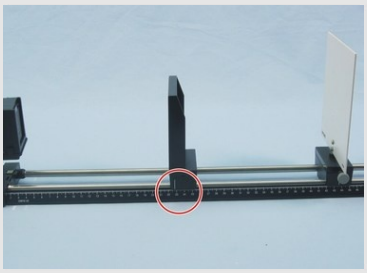

- Connect the lamp to the power supply unit (12 V~) and switch it on.
- Place the lens at a distance of 150 mm from the Perl-L and move the screen until the image of the Perl-L is sharp.

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Procedure (2/3)

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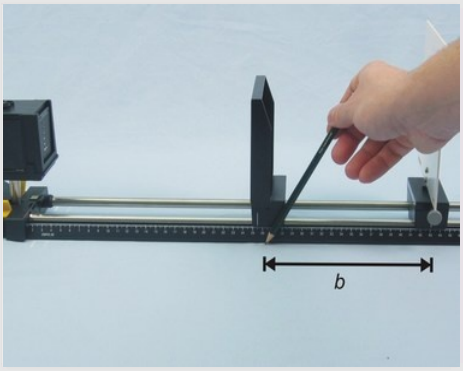
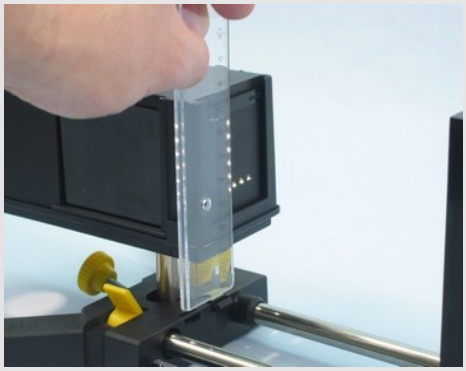
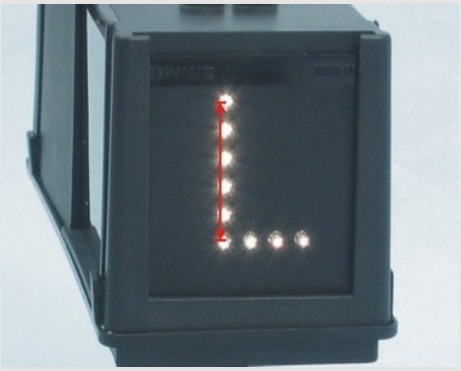
- Measure the distance of the lens from the screen, the image width b and record for an object width $g = 150\,\mathrm{mm}$ in Table 1 in the report.
- Measure the item size G and the image size B. G and B should be the distances between the centres of the top and bottom beads or their images.







Procedure (3/3)

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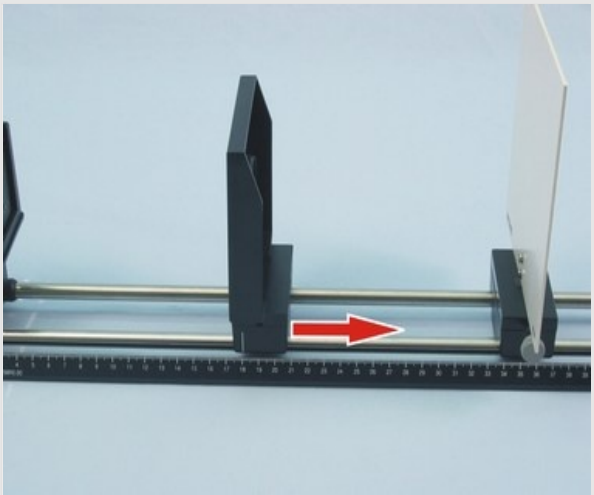

Displacement of the lens

- Create another enlarged and two reduced sharp images of the Perl-L by moving the lens to the right.
- Measure the object width for each of these pictures g, the image width b, the object size G and the image size B. Enter the measured values in Table 1.
- Switch off the power supply unit.

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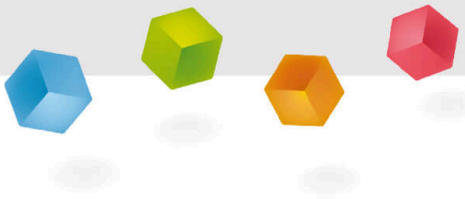

Report

Table 1

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Enter your measurements in the table.

g in mm	b in mm	G in mm	B in mm	g/b	G/B

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Task 1

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Compare the quotients in the individual rows of Table 1. What do you find?

- ○ The quotients b/g and B/G are (almost) the same in the individual lines.
- ○ The quotients b/g are greater in each row than the quotients B/G.
- ○ The quotients b/g are smaller in each row than the quotients B/G.

Check

Task 2

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What is the result of your considerations in mathematical form?

- ○ $g/b > G/B$
- ○ $g/b = G/B$
- ○ $g/b < G/B$

Check

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Task 3

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With which devices do you know that the magnification is important?

- [ ] Camera
- [ ] Windows
- [ ] TV screen
- [ ] Writing projectors
- [ ] Slide projectors

Check

Slide	Score / Total
Slide 20: Comparison of the quotients	0/1
Slide 21: mathematical relation	0/1
Slide 22: Applications	0/3

Total 0 / 5

Solutions Repeat Export text

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