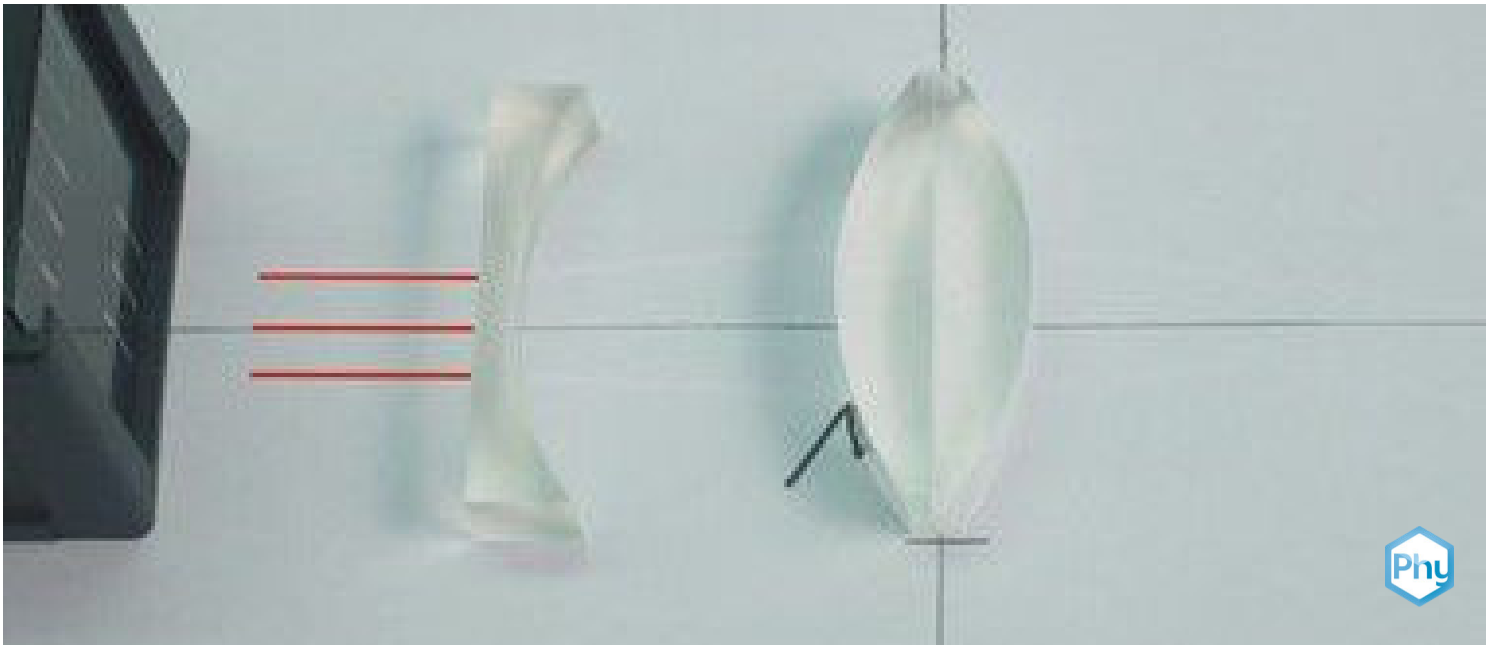
optical path



The task of the experiment is to study the path of light through combinations of convex and concave lenses.

Physics > Light & Optics > Optical devices & lenses

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/616d5c45aeb0ac0003430b33

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Teacher information

Application

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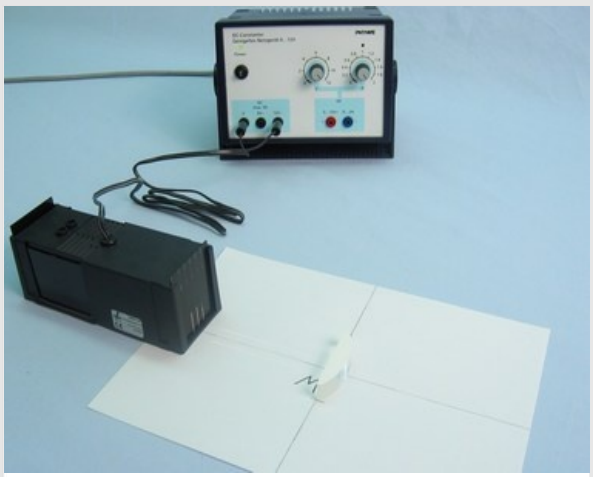

Image construction on lens combinations

Optical devices usually contain not only individual lenses, but combinations of several lenses. Such lens systems have very different properties and are used in many technical areas. Prime examples are optical microscopes and telescopes.

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Other teacher information (1/4)

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Previous

Students should have previously learned the basics of rectilinear propagation, reflection and refraction of light, as well as the construction of pixels. The ray paths of concave and convex lenses should be known.

Principle

Depending on the combination of different lenses, specific ray paths result. For example, in contrast to a plano-convex lens, parallel incident light is not collected at a plano-concave lens, it diverges. Refraction at a plano-convex lens results in a real focal point. When expanded to a biconvex lens, there is more refraction of the parallel incident light.

Other teacher information (2/4)

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Learning objective

With the experiments on the lens combinations, the knowledge of the light path through convex and concave lenses is consolidated and expanded. In addition, the law of refraction is repeated. By combining the plano-concave lens with the bi-convex lens, an attempt is made to convey to the students the knowledge that different total focal lengths can be achieved by the specific combination of lenses and the change in their distance.

Tasks

The task of the experiment is to investigate the path of light through combinations of convex and concave lenses.

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Other teacher information (3/4)

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Note

The experiment is not so demanding in terms of the students' abilities and experimental skills, but skills regarding the conscientious adjustment of the arrangement can be further developed. These are immediate prerequisites for the quantitative determination of the focal length of lens combinations.

Other teacher information (4/4)

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Notes on structure and implementation

The exact adjustment of the respective position of the model bodies, in particular of the plano-convex lenses placed next to each other, with the help of the central light beam incident along the optical axis is the prerequisite for a convincing experimental result.

With the semicircular convex lens included in the equipment set and by changing the order of the lenses used, even more lens combinations can be put together for experimental investigation.

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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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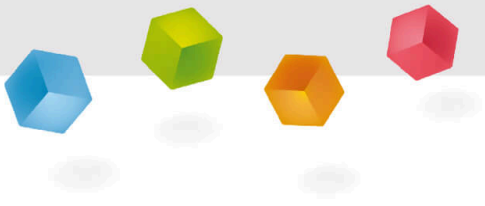

Student Information

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Motivation

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In optical components, there are usually not only concave or converging lenses but combinations of different lens types. In the so-called Galilei telescope, a biconvex lens acts as an objective. It focuses the incident light towards the focal point. A biconcave lens is used as the eyepiece.

Telescope as an example of a lens combination

Task

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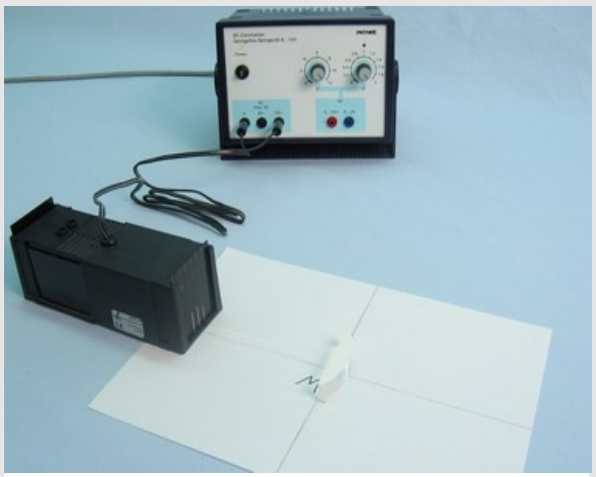

Test setup

How does light travel through lens combinations?

- Examine the path of light through combinations of convex and concave lenses.

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Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Block,planoconvex lens,fl+100mm	09810-04	2
3	Block, planoconcave lens,fl-100mm	09810-05	1
4	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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Additional material

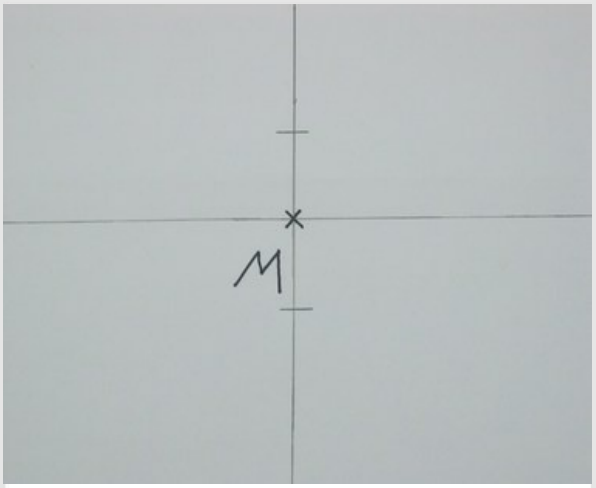
Position	Material	Quantity
1	Ruler (approx. 30cm)	1
2	White paper (DIN A4)	1

Structure (1/2)

Attention!

Make sure that the lenses with the plane surface are each exactly on the vertical line of the line cross and that their position is not changed during experimentation.

- Draw a right-angled cross in the middle of your sheet of paper. Let the intersection of the lines be (\M\).
- Draw at a distance of 3 cm from Mone mark each on the vertical line.



Preparation

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Structure (2/2)

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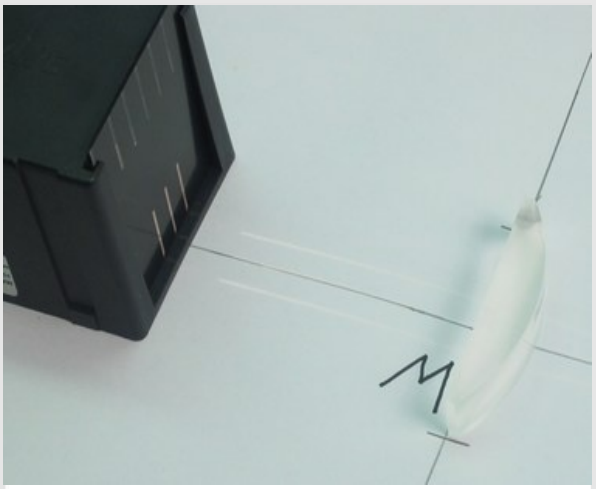
- Place the plano-convex lens (roughened side down) with the planar surface exactly at the vertical line of the line cross within the two markings.
- Insert the triple slit diaphragm into the light box on the lens side and place it about 10 cm away from the flat surface of the model body.



Preparation

Procedure (1/3)

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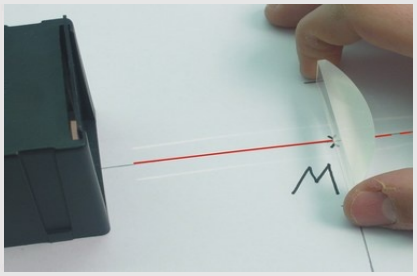
- Connect the light box to the power supply (12 V ~).
- Move the light box and, if necessary, carefully move the lens until the central light beam runs exactly along the optical axis and is not refracted when passing through the lens.
- Observe the path of the parallel light as it passes through the lens and note your observations.
- Mark the position of the focal point on the optical axis.



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Procedure (2/3)

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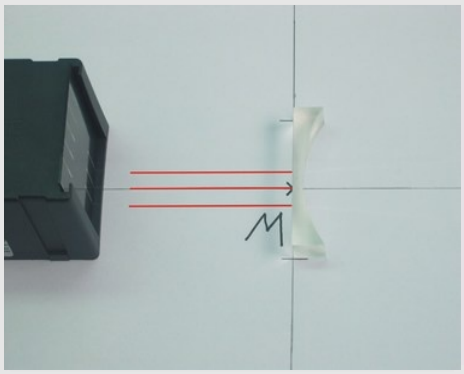
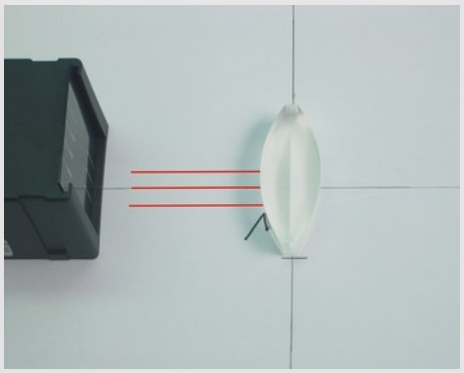
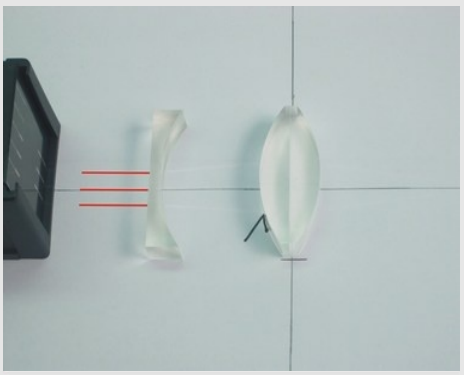
- Change your experimental set-up according to the following illustrations.
- Observe the course of the light and in particular the position of the focal point. Note down all observations.







Procedure (3/3)

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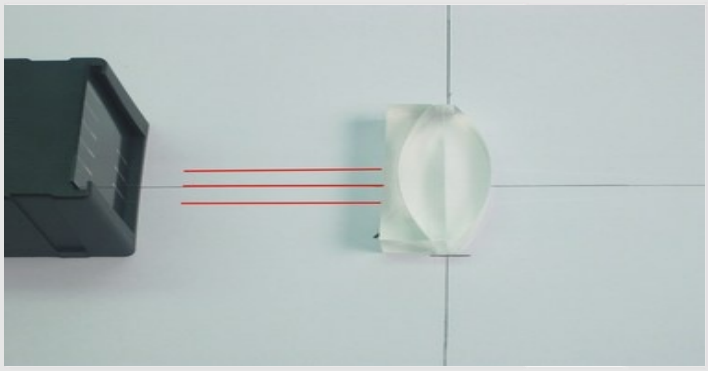
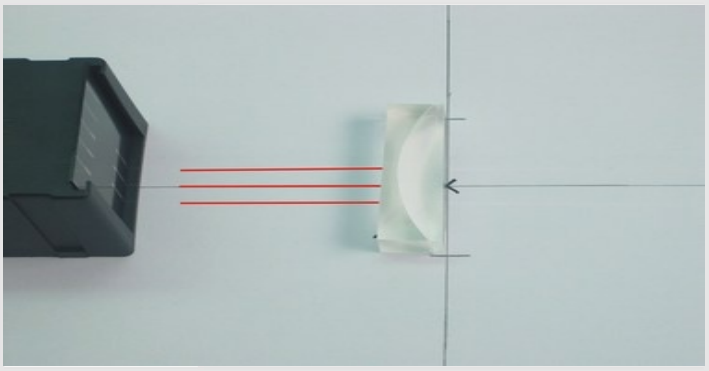
- Change your experimental set-up again according to the following figures and note down all your observations
- Switch off the power supply and remove the light box and the model body from the paper.





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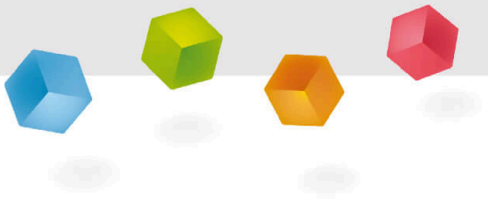

Report

Task 1

10° PHYWE

Evaluate the truth of the following two statements:

In contrast to a plano-convex lens, parallel incident light is not collected at a plano-concave lens, it diverges. Refraction at a plano-convex lens results in a virtual image.

○ True ○ False

Check

If a plano-convex lens is supplemented to a bi-convex lens, a stronger refraction of the parallel incident light takes place, the focal point is closer to the lens, the focal length is thus smaller.

○ True ○ False

Check

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Task 2

PHYWE

10°

How can the focal length of a lens system be changed?

- [ ] By rotating the lenses 180°.
- [ ] By combining a biconvex lens with a (plano) concave lens.
- [ ] By varying the distance between the individual lenses.

Check

Task 3

PHYWE

What does the combination of a plano-concave lens and a plano-convex lens with the same curvature do?

The light is refracted by 30° when passing through the compound lenses (of the same curvature). This lens system acts like a plane-parallel glass plate onto which light is incident perpendicularly (angle of incidence 0°) and is therefore refracted by an angle of 30°.

The light is no longer refracted when passing through the compound lenses (of the same curvature). This lens system acts like a plane-parallel glass plate onto which light falls perpendicularly (angle of incidence 0°) and is therefore not refracted.

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Task 4

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Where are lens combinations used?

- [ ] Telescope
- [ ] Glasses
- [ ] Camera with zoom lens
- [ ] Magnifier
- [ ] Microscope

Check

Historical telescope

Slide	Score / Total
Slide 19: Multiple tasks	0/2
Slide 20: Untitled Multiple Choice	0/2
Slide 21: Combination plano-concave and plano-convex lens	0/1
Slide 22: Application of lens combinations	0/3

Total 0 / 8

Solutions Repeat

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