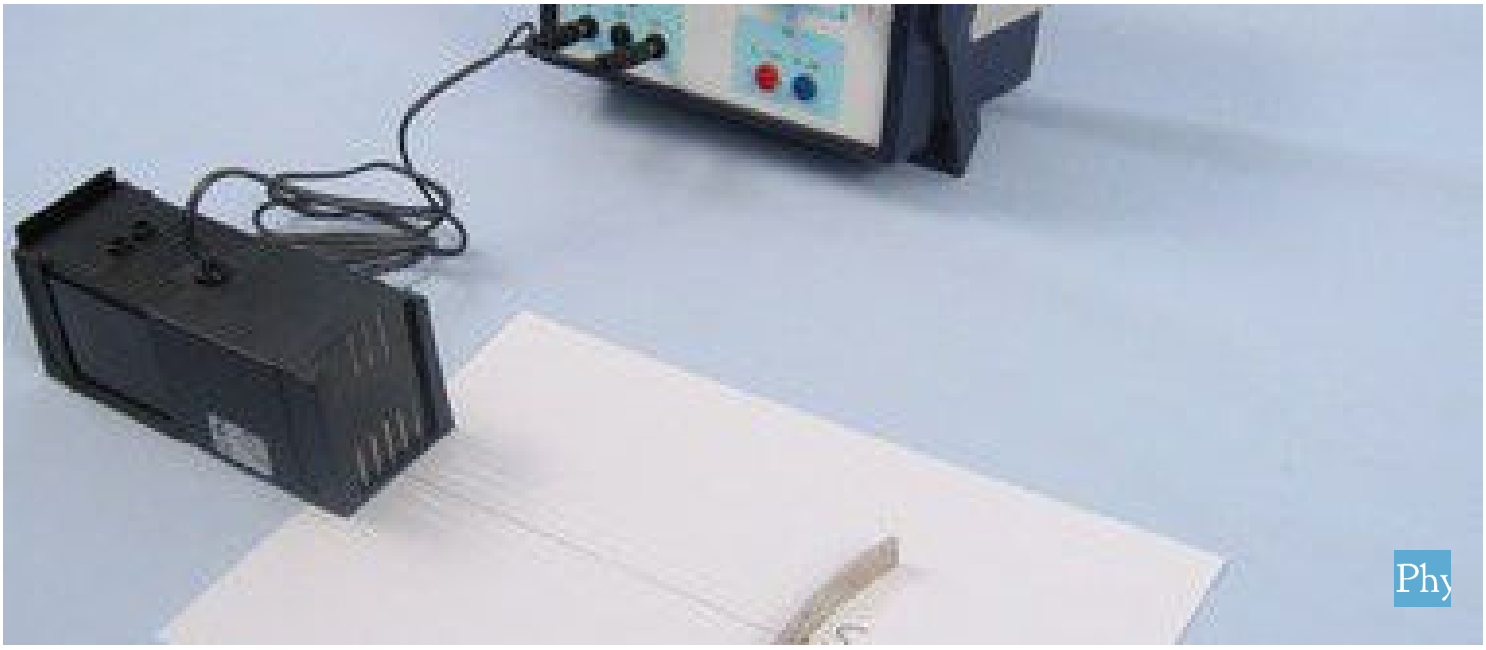
Image construction at the camber mirror



Physics > Light & Optics > Reflection & refraction of light

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

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Teacher information

Application

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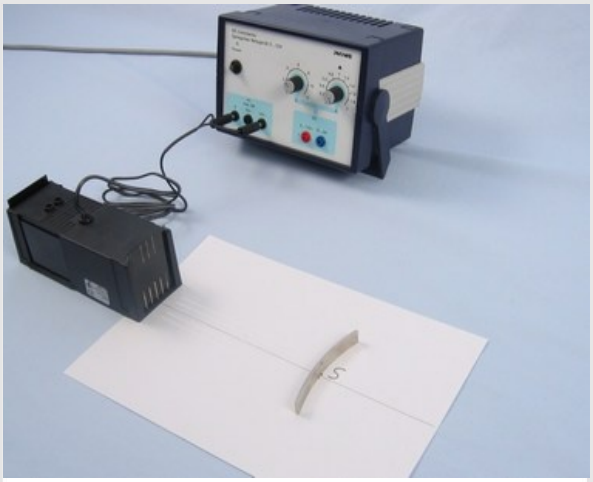

Reflection at the camber mirror

A convex mirror is a mirror that is curved outwards. Usually parts of spheres are used for this purpose, onto which the light falls from the outside. Especially in road traffic, such mirrors are used to view larger areas or unclear places.

But also at Christmas time we encounter Wöbspiegel in the form of shiny Christmas tree baubles. If you look at the mirror image, you can see a reduced, upright image.

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Other teacher information (1/4)

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Previous

The students should have previously learned the basics of the rectilinear propagation of light and the application of the law of reflection. They should also be able to draw individual ray paths and construct pixels.

Principle

Convex mirrors have a characteristic beam path. The reflected light rays appear to come from a point behind the mirror. Light beams incident on the convex mirror parallel to the optical axis run outwards after reflection, they diverge. Light rays incident along the optical axis are reflected within themselves.

Other teacher information (2/4)

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Learning

With this experiment, the students are to become acquainted with a procedure that makes it possible to construct the image on the convex mirror for a given object. Selected light beams and their characteristic course are used for this purpose.

Tasks

The aim of this experiment is the experimental determination of the intersection point of selected light beams incident on a convex mirror and the resulting possibility of image construction. In a preliminary experiment, the properties of the mirror image are first determined, thus making it possible to compare the two experimental results later.

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Other teacher information (3/4)

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Additional information

The experiment is very demanding in terms of the assumed experimental skills of the students and the knowledge that is gained. No real images are obtained. The intersection point of the backward extended reflected light beams lies behind the convex mirror.

This gives the student the opportunity to explain the nature of virtual (apparent) images and to deepen his knowledge of virtual images on the plane mirror.

Other teacher information (4/4)

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Notes on structure and implementation

It must be ensured that the adjustment of the mirror (centre of the outward curved surface is at point S of the optical axis) and the light box (incidence of the narrow beam of light along the optical axis to check the correct setting) is carried out very carefully by the student in order to arrive at a clear and convincing result.

To facilitate the parallel displacement of the light box, a thin pencil line parallel to the optical axis should be drawn through the tip of the object arrow to the camber mirror before the experiment.

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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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We encounter mirrors every day in a wide variety of designs. A special type of mirror is the so-called convex mirror. This is a mirror that is curved outwards. Often, partial surfaces of spheres are used for this purpose, onto which the light shines from the outside.

A typical example of a camber mirror is a Christmas tree ball, as shown in the picture on the right. Have you ever looked at your reflection in a sphere, do you notice anything special?

Christmas tree balls

Task

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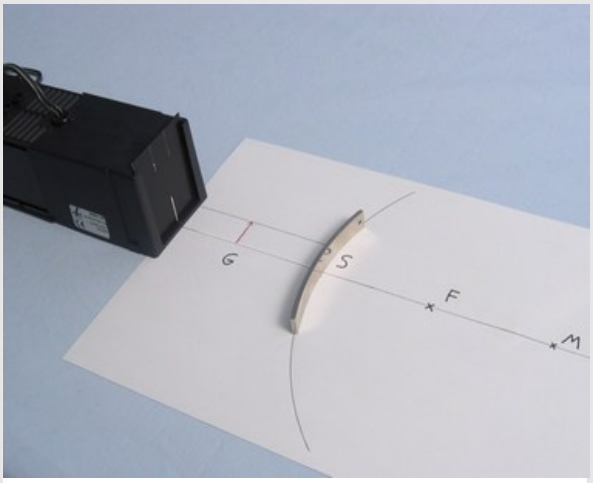

Test setup

Why do you see yourself diminished in a shiny Christmas bauble?

1. investigate the properties of the mirror on a convex mirror.

Investigate the formation of images on a convex mirror using selected light beams.

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Material

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Mirror, concave-convex	09812-00	1
3	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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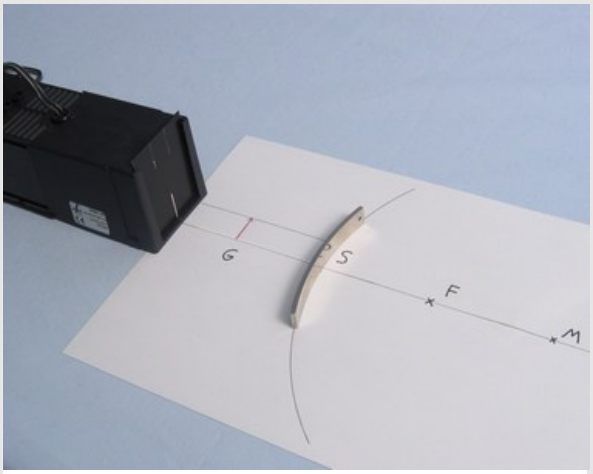
Additional material

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

Structure



Test setup

Attention

Make sure that the camber mirror is always aligned with the center of the outer camber on the point S and does not change its position when the light box is moved.

1. properties of the mirror image

- Look into the convex mirror held vertically in front of your face. What characteristics of your reflection do you notice? Write down your observations in the protocol.

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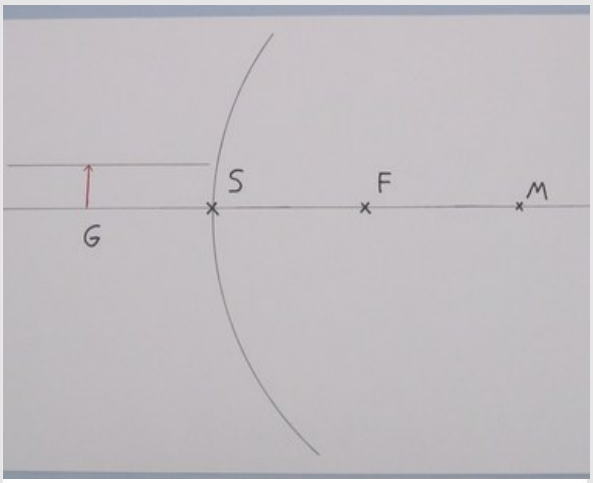
Procedure (1/5)



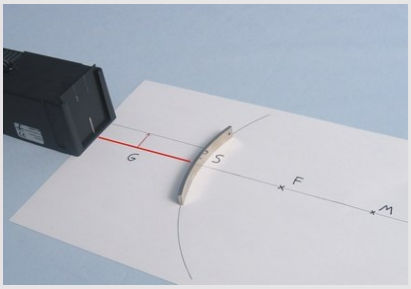
Moving the light box

2. image formation at the camber mirror

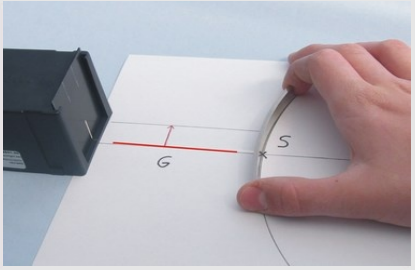
- Prepare a sheet of paper as shown on the left
- The routes $\overline{FS}$ and $\overline{MS}$ are 7.2 cm each; the circle around M has the radius $\overline{MS}$.
- Draw at a distance of 6 cm from the point S (opposite of F and M) draw a vertical arrow, 2 cm long, on the optical axis and denote it by G (Subject).
- Draw a thin auxiliary line parallel to the optical axis, passing through the tip of the arrow.

Procedure (2/5)

- Insert the slit diaphragm into the light box on the lens side. Place the light box and the convex mirror on your sheet of paper.



- Connect the light box to the power supply (12 V ~).
- Check the adjustment of the camber mirror by letting the narrow beam of light fall along the optical axis.



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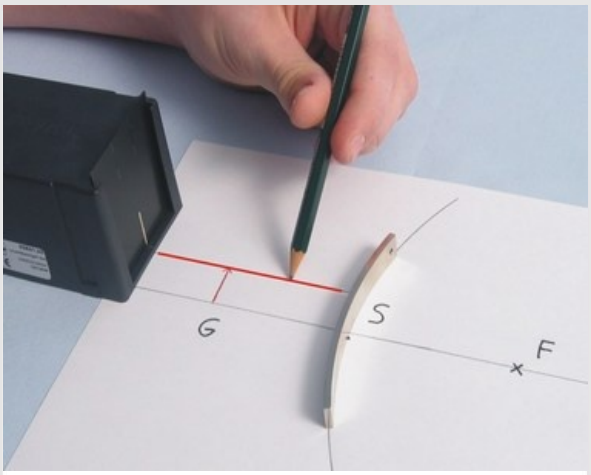
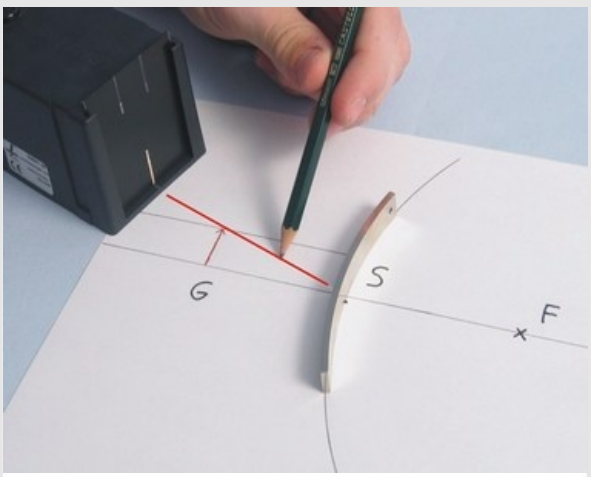
Implementation (3/5)



Moving the light box

- Now move the light box until the narrow light beam runs parallel to the optical axis along the auxiliary line and through the tip of the arrow (imaginary object).
- Observe the light beam reflected by the convex mirror and mark the course of the incident and reflected light beam with two crosses each.

Procedure (4/5)



Turning the light box

- Turn the light box until the light beam is exactly in the direction of the dot S but still through the tip of the object arrow G is running.
- Again, observe the light beam reflected by the convex mirror and mark the course of the incident and reflected light beam twice with crosses (use a different color or marker).

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Procedure (5/5)

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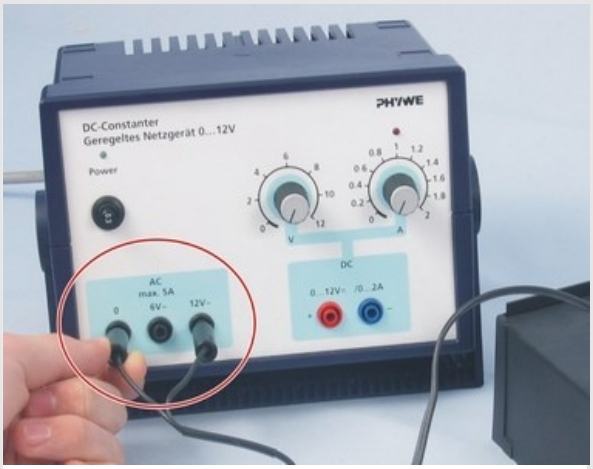

Picture of the power supply unit

- Turn off the power supply and remove the light box and the camber mirror from the sheet of paper.
- Connect the matching crosses so that the course of the light beams before and after the reflection at the convex mirror becomes clear.
- Extend the reflected light rays beyond the mirror with broken lines. What can you determine?
- Write down your observations.

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Protocol

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Task 1

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Consider the following statement:

If the object is at a distance of 6 cm from the convex mirror, the image is at a shorter distance but on the other side.

The image is reduced and upright (it is a virtual/apparent image).

○ True ○ Incorrect

Check

Task 2

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Why do you see yourself diminished in a shiny Christmas bauble?

A _____ Christmas tree ball is a small _____. Thus, the _____ and the laws about the course of selected _____ also apply to it.
As a result, a _____, upright, (apparent) _____ results from the _____.

shiny
observer
image
curved mirror
diminished
light beams
law of reflection

Check

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Task 3

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Draw a straight line from the tip of the object arrow G to the point M. What can you tell?

How would a beam of light incident on the convex mirror along this straight line be reflected?

The _____ also passes through the _____ of the other two selected light rays and thus through the _____ of the image arrow on its way to the _____ lying behind the concave mirror. A light beam incident on the _____ behind the concave mirror is reflected into itself (angle of incidence = _____ = _____).

- centre of curvature
- intersection
- 0°
- straight line
- angle of reflection
- tip
- centre M

Task 4

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What is special about the images created at the camber mirror?

- The images on the convex mirror are behind the mirror. Therefore, as with the plane mirror, they are apparent images.
- The images on the camber mirror are in front of the mirror. They are therefore real images

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Slide	Score/Total
Slide 20: Properties of the image	0/1
Slide 21: Christmas ball as a camber mirror	0/7
Slide 22: Interpretation of the beam path	0/7
Slide 23: Apparent images at the camber mirror	0/1

Total 0/16

Solutions Repeat

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