REFLECTION IN A MIRROR

EXPERIMENT PROCEDURE

- **Demonstrate the law of reflection using a plane mirror.**
- **Determine the focal length of a concave mirror and demonstrate that it too obeys the law of reflection.**
- **Determine the virtual focal length of a convex mirror.**

OBJECTIVE

Investigate reflection from a plane mirror and a curved mirror

SUMMARY

Light rays are reflected by a mirror such that the angle of incidence is equal to the angle of reflection. This law of reflection applies not only to plane mirrors but also to curved ones. Only plane mirrors, though, reflect parallel incident rays in such a way that they remain parallel upon reflection. This is because the angle of incidence of all these parallel rays will be the same. For curved mirrors, concave and convex, parallel rays do not remain parallel after reflection. Instead, they are focussed towards a focal point.

REQUIRED APPARATUS

Quantity	Description	Number
1	Optical Bench U, 1200 mm	**1003039**
3	Optical Rider U, 75 mm	**1003041**
1	Optical Rider U, 35 mm	**1003042**
1	Optical Lamp with LED	**1020630**
1	Iris on Stem	**1003017**
1	Object Holder on Stem	**1000855**
1	Optical Disc with Accessories	**1003036**
1	Set of 5 Slit and Hole Diaphragms	**1000607**

BASIC PRINCIPLES

Light rays are reflected by a mirror such that the angle of incidence is equal to the angle of reflection. This law of reflection applies not only to plane mirrors but also to curved ones. Only plane mirrors, though, reflect parallel incident rays in such a way that they remain parallel upon reflection. This is because the angle of incidence of all these parallel rays will be the same.

If parallel light rays strike a plane mirror at angle α, the law of reflection indicates that they should be reflected to an angle β:

(1) $$\alpha = \beta$$

α: Angle of incidence, β: Angle of reflection

In this experiment the angle of reflection will be measured directly for three parallel beams and it will be determined how this angle is related to the angle of incidence.

If a light ray which is parallel to the optical axis is incident upon a concave mirror, the law of reflection says that it will be reflected symmetrically about a normal to the point of incidence and will then cross the optical axis at the following distance from the mirror:

(2) $$f_\alpha = r - \overline{MF} = r\cdot\left(1-\frac{1}{2\cdot\cos\alpha}\right).$$

(See Fig. 1 for path of rays on left-hand side). For rays close to the optical axis itself, cos α is close to 1, therefore

(3) $$f = \frac{r}{2}.$$

This is not dependent on the distance from the optical axis, which means that all parallel rays near to the optical axis will, after reflection, converge at the same point (the focal point) on the optical axis a distance f (the focal length) from the surface of the convex mirror. If parallel rays strike the mirror at an angle α to the optical axis, they will be reflected through a common point away from the optical axis. The geometric relationships for a convex mirror are similar to those for a concave mirror except that the rays diverge rather than converge after reflection. The diverging rays, however, do appear to have a point of convergence at a virtual focal point f' behind the mirror (see Fig. 1 for path of rays on right-hand side). The virtual focal length f' for a convex mirror is given by the following:

(4) $$f' = -\frac{r}{2}.$$

In the experiment the focal length of the concave mirror and the virtual focal length of the convex mirror will be determined from the paths of the rays on an optical disc. The validity of the law of reflection will be checked for the ray in the centre.

EVALUATION

Parallel light rays incident upon a plane mirror are reflected back as parallel rays. The law of reflection applies to this process.

When a beam of parallel rays is reflected by a concave mirror, the angle of incidence is different for each of the rays and all the rays are then focussed towards a focal point.

Similarly, when a beam of parallel rays is reflected by a convex mirror, the rays converge at a virtual focal point behind the mirror.

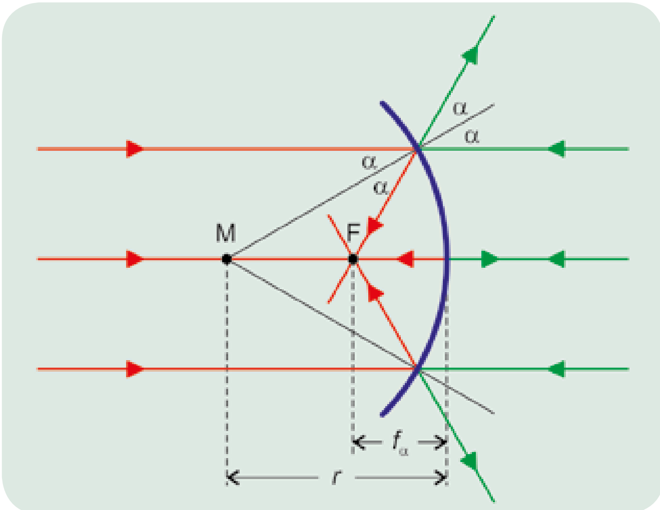

Fig. 1: Schematic for determining focal length of a concave mirror and a convex mirror

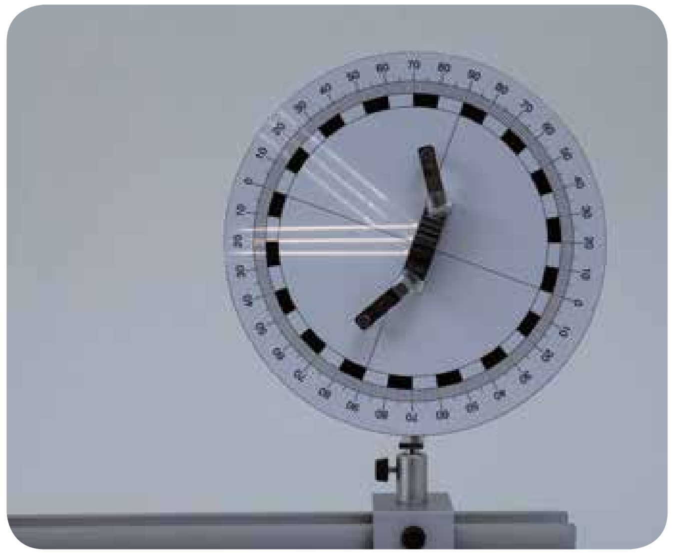

Fig. 2: Reflection of three parallel rays by a plane mirror

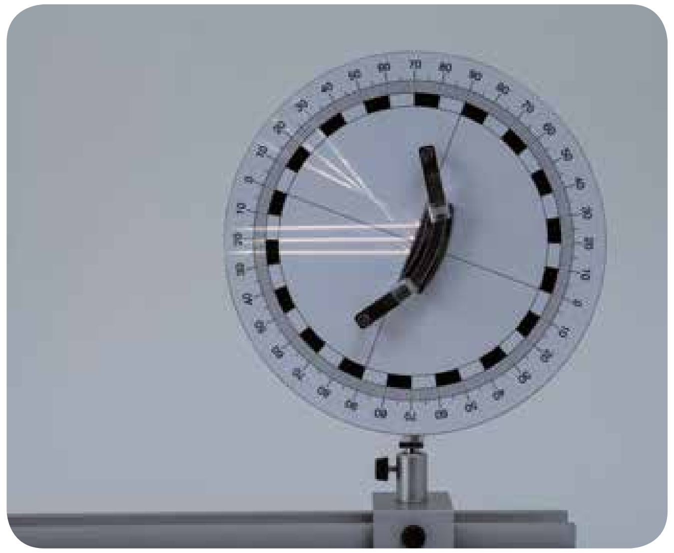

Fig. 3: Reflection of three parallel rays by a concave mirror

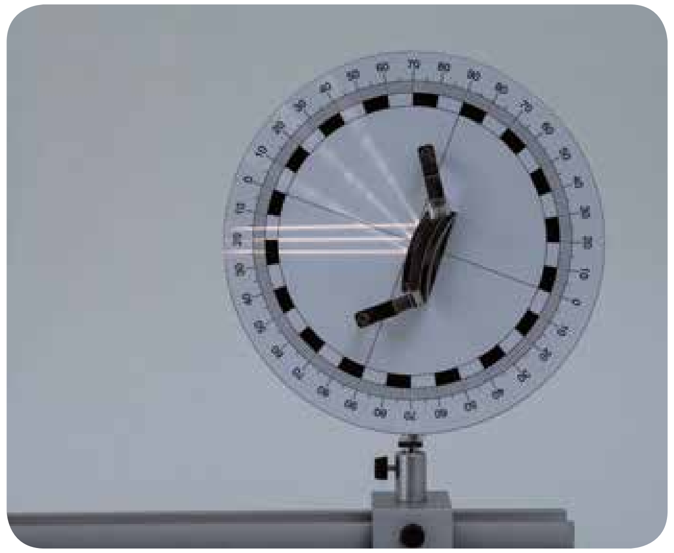

Fig. 4: Reflection of three parallel rays by a convex mirror

You can find technical information about the equipment at 3bscientific.com

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