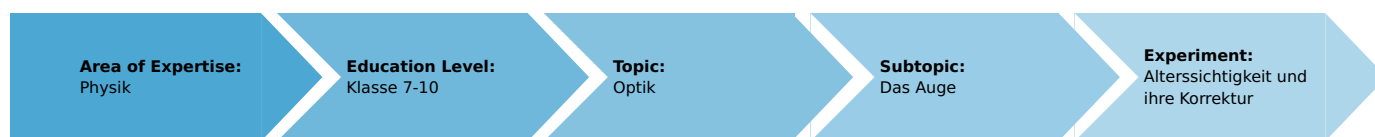


# Accommodation defects in old age and their correction

(Item No.: P1067000)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



10 Minutes

### Recommended Group Size



2 Students

### Additional Requirements:

- White paper (DIN A4)
- Compasses
- Ruler (approx. 30 cm)

### Experiment Variations:

### Keywords:

## Task and equipment

## Information for teachers

## Additional Information

In this experiment, the students should review their knowledge of the light path in the human eye and the accommodation of the eye to near and far objects. From the observation of the inadequate accommodation for divergent incident light using the model eye and therefore the necessity of its correction with the help of a convex lens, they should reach conclusion concerning the appearance of old-age accommodation problems. The experiment gives an understanding of why older people very often require glasses for close reading. This allows a differentiation between this type of defects and the short- and long-sightedness due to inherently flawed eye structure.

The experiment is demanding in terms of the abilities and skills required of the students, particularly in the necessity to extrapolate from the planar model to the real eye.

## Suggestions

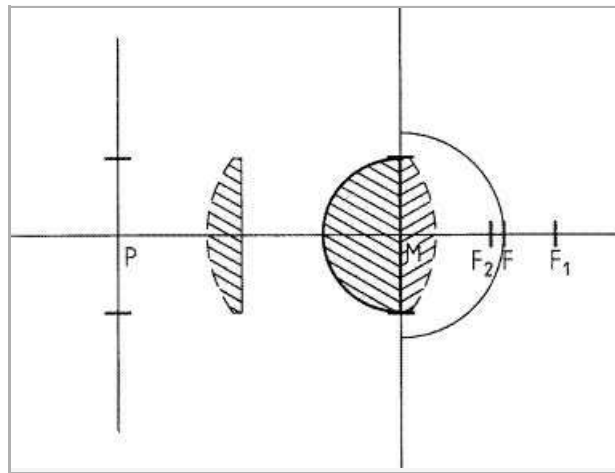
If the students have already performed the experiments on the functioning of the eye and defective vision, they should not have great difficulties in setting up and conducting this experiment. The accommodation of the eye to the objects close to it is simulated by the insertion of the thin, planoconvex lens. One should ensure that this lens lies within the plane surface closely against the semicircular convex lens serving as the eye lens and that the position of the eye lens is not changed in the process. Furthermore, care should be taken that the convergence point of the incident light is always on the optical axis in all parts of the experiment. With the light box placed symmetrically to the optical axis and the additional lens brought into the light path, this can easily be achieved. The marking of the outline of the lens and the focal point serve to facilitate the subsequent discussion.

## Remark

Problems of accommodation associated with old age are caused by the hardening of the lens and the consequent decreased ability to accommodate. In this way, old people can no longer focus near objects sharply on the retina; the focal length of the eye lens is no longer short enough. A remedy is the wearing of spectacles with convex lenses, which are only worn for near vision.

## Remark on Result - Table 1

The students' drawing should correspond to that in the Figure below.



# Accommodation defects in old age and their correction

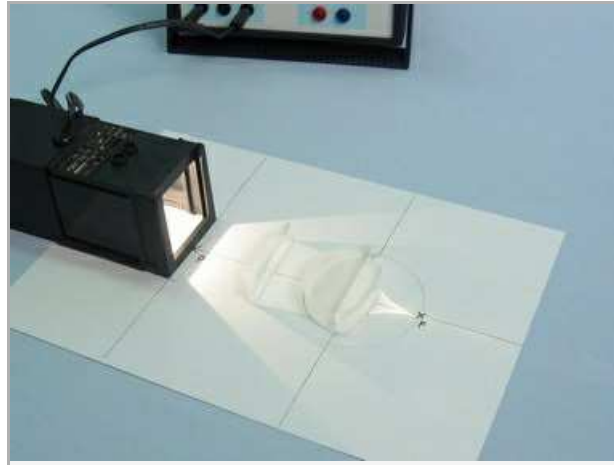
(Item No.: P1067000)

## Task and equipment

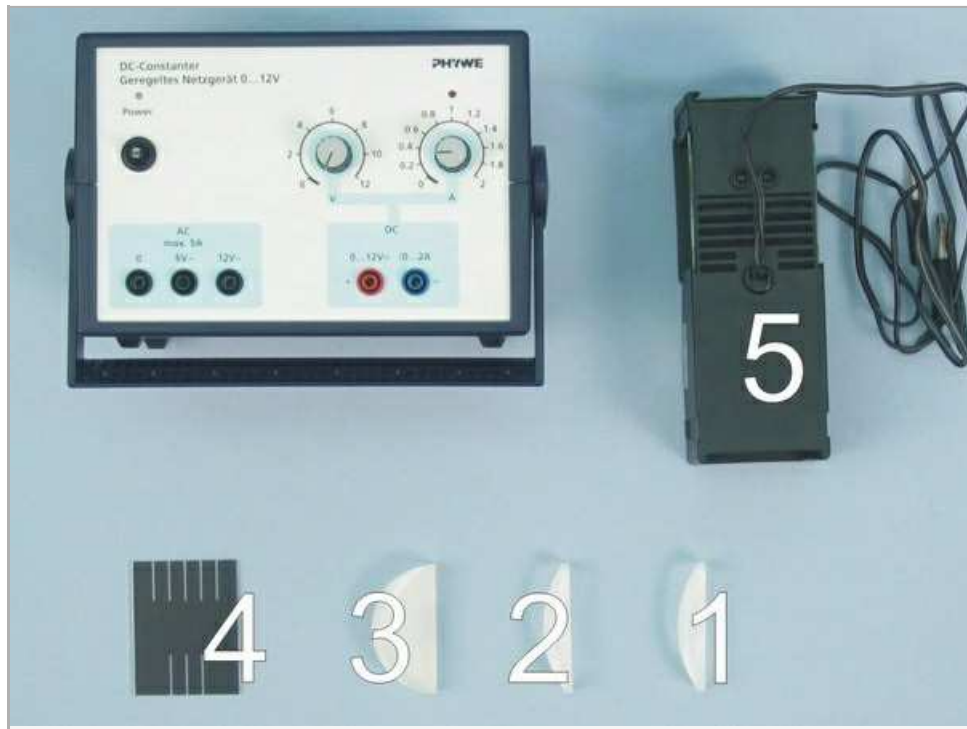
### Task

#### What is loss of accommodation in old age?

Investigate with the model eye how the problems of accommodation associated with old age can be corrected.



Equipment



Position No.	Material	Order No.	Quantity
1, 2	Block, planoconvex lens, fl+100mm	09810-04	2
3	Block, semicircular	09810-01	1
4, 5	Light box, halogen 12V/20 W	09801-00	1
	PHYWE power supply DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
Additional material			
	White paper (DIN A4)		1
	Compasses		
	Ruler (approx. 30 cm)		1

## Set-up and procedure

### Set-up

## Attention!

Ensure that the semicircular eye lens always lies with its plane surface on the perpendicular of the crossed lines and that its adjusted position does not change on moving the light box.

### Setup

- Prepare a sheet of paper as shown in the picture.
- At a distance of 10 cm and 21 cm from the right edge draw crossed lines at right-angles (the intersection points of the lines are M and P) and make marks on both sides of M and P at a distance of 3 cm.

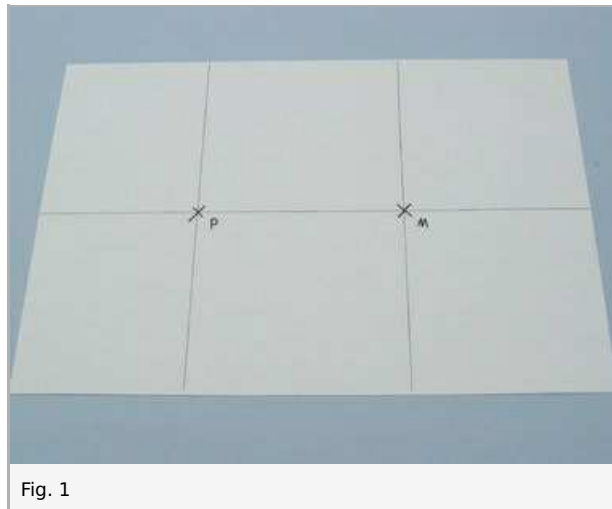


Fig. 1

- Draw a semicircle from M with a radius of 3 cm. Furthermore, draw a second semicircle from M with a radius of 4 cm. The intercept with the optical axis is F. This semicircle represents the retina in your eye model.

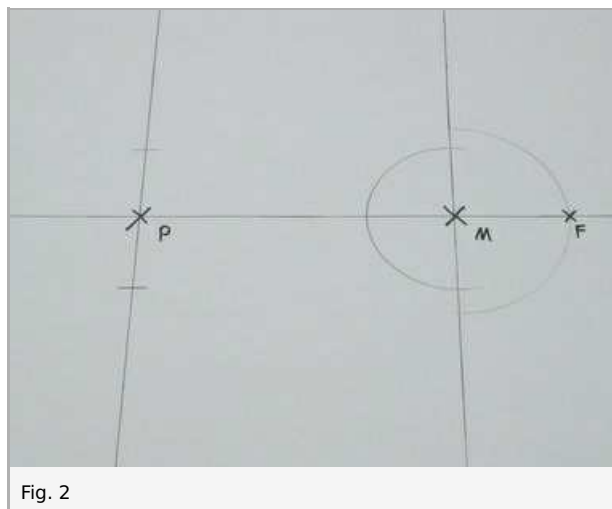


Fig. 2

- Place the semicircular convex lens with the plane surface precisely within the smaller semicircle. This lens represents the eye's lens in your model.
- Insert the three-slit into the light box on the lens side and position the light box as shown.

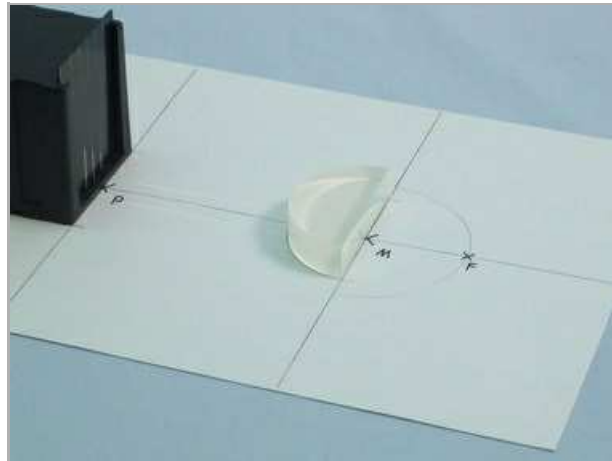


Fig. 3

## Procedure

### 1. Seeing distant objects

- Connect the light box to the power supply (12 V AC) and switch it on.



Fig. 4

- Move the light box until the middle light beam travels precisely along the optical axis and passes unrefracted through the lens.
- If necessary move the lens carefully along the perpendicular line. Carefully mark the outline of the convex lens without moving it in the process.
- Observe the path of the parallel light after passing through the semicircular lens, in particular the focal point. Note your observations in the table in the report.

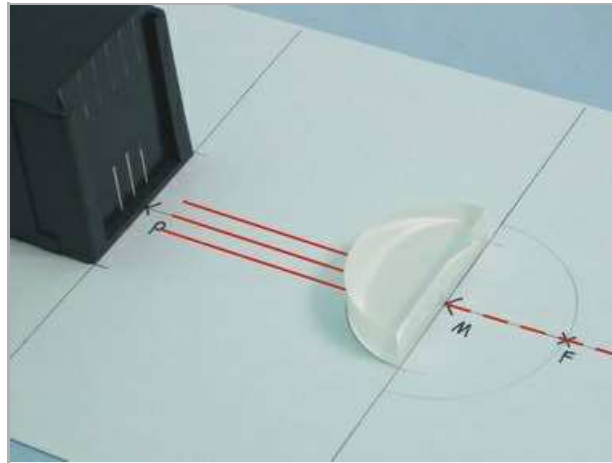


Fig. 5

## 2. Seeing near objects

- Rotate the light box through 180° and remove the aperture so that now the divergent light falls on the domed side of the lens.  
Move the light box to the perpendicular line (point P) so that it is positioned within the markings.
- Describe the path of the light behind the lens.



Fig. 6

- Place the thin, planoconvex lens against the plane surface of the eye lens.



Fig. 7

- Mark the outline of the lenses for this case.
- At the same time observe the change in the light path and mark, by approximation, the tip of the light beam. Label this F1.

Note your observations.

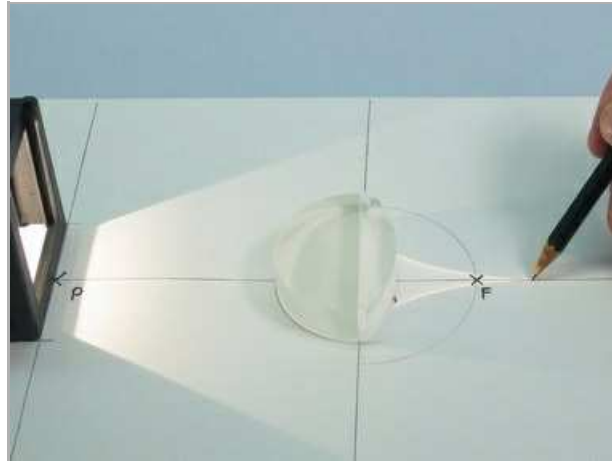


Fig. 8

- Lay the second planoconvex lens between the light box and the eye lens. Describe the path of the light. Mark the tip of the cone of light with F2.
- Move this planoconvex lens a little. To which line can you shift the point F2? Note your observations.

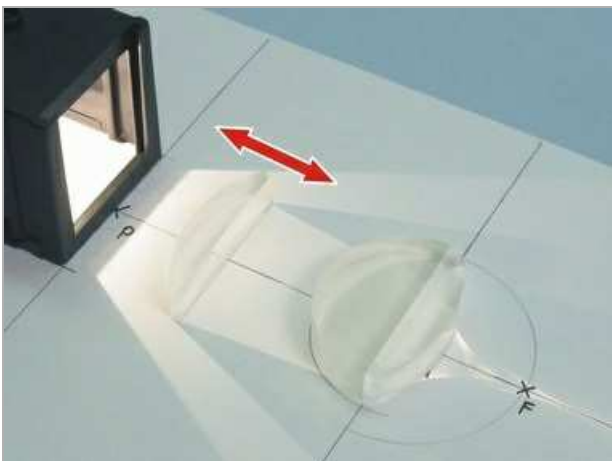


Fig. 9



Fig. 10

- Switch off the power supply and remove the light box and the block from the paper.



## Report: Accomodation defects in old age and their correction

### Result - Table 1

Note your observations in the table.

	Experimental conditions	Observations
1.	Parallel light along the optical axis	
2.	Divergent light, the light box at P	
	Setup as before, supplementary lens behind the eye lens (accomodation)	
	Setup as before, supplementary lens in front of the eye lens	
	Setup as before, movement of the supplementary lens	

### Evaluation - Question 1

Compare your observations in Table 1 on the path of parallel and divergent light after striking the semicircular lens. What is there in common?

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### Evaluation - Question 2

Object points far away from the eye give out virtually parallel light. Formulate a statement on the path of the light in the human eye for distant objects.

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### Evaluation - Question 3

What changes when the lens illuminated by divergent light is supplemented by an additional planoconvex lens?

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### Evaluation - Question 4

Divergent light rays reach the eye from objects located close to the eye. How does the human eye try to accommodate to this object position?

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### Evaluation - Question 5

With increasing age, the ability of the eye to adjust (ability to accommodate) to near objects (divergent incident light) generally decreases. What is the effect of this defect associated with old age?

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### Evaluation - Question 6

What function do spectacles with convex lenses (which opticians call positive glasses) have for older people? When are they worn?

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